ay-June 1956

Communications—Electronics—Photography

SIGNAL

10th Annual AFCEA Convention & Exhibits

☆ ☆ ☆ ☆

Souvenir Program Issue

Including Convention Program

and Index to Exhibits

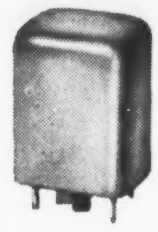
Pages 7-19

MINIATURIZED TRANSFORMER COMPONENTS

FRO STOC

Items below and 650 others in our catalog A.

HERMETIC SUB-MINIATURE AUDIO UNITS



These are the smallest hermetic audios made.

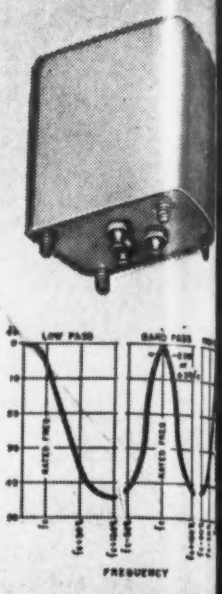
Dimensions . . . 1/2 x 11/16 x 29/32 . . . Weight.8 oz.

TYPICAL ITEMS

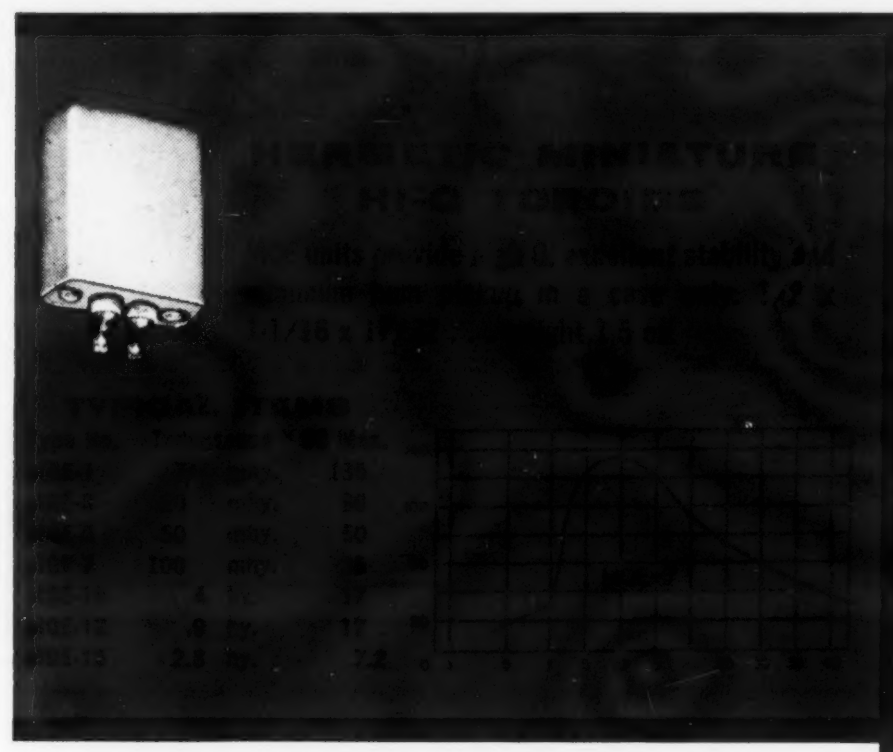
Type No.	Application	MIL Type	Pri. Imp. Ohms	Sec. Imp. Ohms	DC in Pri MA	Response ±2 db (Cyc.)	Max. level dbm
H-30	Input to grid	TF1A10YY	50*	62,500	0	150-10,000	+13
H-31	Single plate to single grid, 3:1	TF1A15YY	10,000	90,000	0	300-10,000	+13
H-32	Single plate to line	TF1A13YY	10,000*	200	3	300-10,000	+13
H-33	Single plate to low impedance	TF1A13YY	30,000	50	1	300-10,000	+15
H-34	Single plate to low impedance	TF1A13YY	100,000	60	.5	300-10,000	+ 6
H-35	Reactor	TF1A20YY	100 Henries-0 DC, 50 Henries-1 Ma. DC, 4,400 ohms.				
H-36	Transistor Interstage	TF1A15YY	25,000	1,000	.5	300-10,000	+10

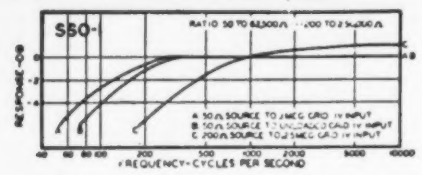
*Can be used with higher source impedances, with corresponding reduction in frequency range and current

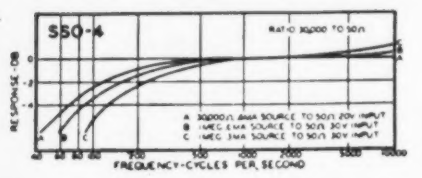
COMPACT HERMETIC AUDIO FILTERS



UTC standardized filters are for low pass, high pass, and band pass application in both interstage and line impedance designs. Thirty four stock values, others to order. Case 1-3/16 x 1-11/16 x 1-5/8—2-1/2 high . . . Weight 6-9 oz.




SSO-1
RATIO 50 TO 62,500Ω
A 50Ω SOURCE TO 2 MEG GRID IV INPUT
B 50Ω SOURCE TO 500Ω GRID IV INPUT
C 200Ω SOURCE TO 2 MEG GRID IV INPUT
RESPONSE-DB
FREQUENCY-CYCLES PER SECOND

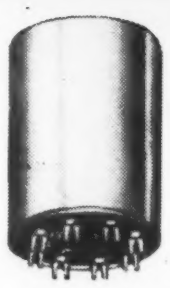

SSO-4
RATIO 30,000 TO 50Ω
A 30,000Ω 4MA SOURCE TO 50Ω 20V INPUT
B 2 MEG 2 MA SOURCE TO 50Ω 30V INPUT
C 2 MEG 3MA SOURCE TO 50Ω 30V INPUT
RESPONSE-DB
FREQUENCY-CYCLES PER SECOND

SUB-SUBOUNCER AUDIO UNITS

UTC Subouncer and sub-subouncer units provide exceptional efficiency and frequency range in miniat size. Constructional details assure maximum re bility. SSO units are 7/16 x 3/4 x 43/64 . . . We 1/50 lb.

Type	Application	Level	Pri. Imp.	MA D.C. in Pri.	Sec. Imp.	Pri. Res.	Sec. R
*SSO-1	Input	+ 4 V.U.	200 50	0	250,000 62,500	13.5	3
SSO-2	Interstage /3:1	+ 4 V.U.	10,000	0-.25	90,000	750	3
*SSO-3	Plate to Line	+20 V.U.	10,000 25,000	3 1.5	200 500	2600	
SSO-4	Output	+20 V.U.	30,000	1.0	50	2875	
SSO-5	Reactor 50 HY at 1 mil. D.C. 4400 ohms D.C. Res.						
SSO-6	Output	+20 V.U.	100,000	.5	60	4700	
*SSO-7	Transistor Interstage	+10 V.U.	20,000 30,000	.5 .5	800 1,200	850	

* Impedance ratio is fixed, 1250:1 for SSO-1,1:50 for SSO-3.
Any impedance between the values shown may be employed.

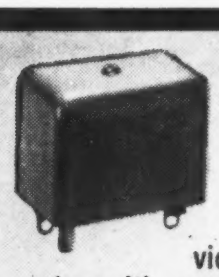


OUNCER (WIDE RANGE) AUDIO UNITS

Standard for the industry for 15 yrs., these units provide 30-20,000 cycle response in a case 7/8 dia. x 1-3/16 high. Weight 1 oz.

TYPICAL ITEMS

Type No.	Application	Pri. Imp	Sec. Imp
0-1	Mike, pickup or line to 1 grid	50, 200/250, 500/600	50,000
0-4	Single plate to 1 grid	15,000	60,000
0-7	Single plate to 2 grids, D.C. in Pri.	15,000	95,000
0-9	Single plate to line, D.C. in Pri.	15,000	50, 200/250, 500/600
0-10	Push pull plates to line	30,000 ohms plate to plate	50, 200/250, 500/600
0-12	Mixing and matching	50, 200/250	50, 200/250, 500/600
0-13	Reactor, 300 Hys.—no D.C.; 50 Hys.—3 MA. D.C., 6000 ohms		

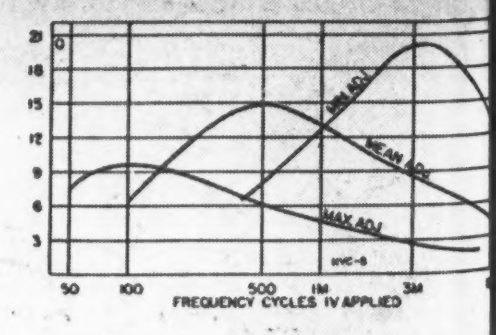


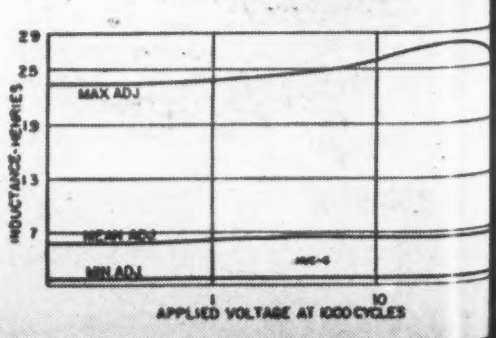
HERMETIC VARIABLE INDUCTORS

These inductors provide high Q from 50 - 10,000 cycles with exceptional stability. Wide inductance range (10 - 1) in an extremely compact case 25/32 x 1-1/8 x 1-3/16 . . . Weight 2 oz.

TYPICAL ITEMS

TYPE No.	Min. Hys.	Mean Hys.	Max. Hys.	DC Ma
HVC-1	.002	.006	.02	100
HVC-3	.011	.040	.11	40
HVC-5	.07	.25	.7	20
HVC-6	.2	.6	2	15
HVC-10	7.0	25	70	3.5
HVC-12	50	150	500	1.5





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SEND DETAILS OF YOUR NEEDS for SIZES and PRICES

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EXPORT DIVISION: 13 E. 40th St., New York
CABLES: "ARLAB"

Telephone Man Helps Save Five from Tidal Waters

Quick action prevents tragedy when family is marooned in hurricane

AWARDED MEDAL—Robert A. Gillespie, of Block Island, R. I., was awarded the Vail Medal for "courage, endurance and ingenuity" in helping to rescue five people marooned by tidal waters. Vail Medals, accompanied by cash awards, are given annually by the Bell System for acts of noteworthy public service by telephone employees.

Hurricane winds of 110 miles an hour were creating a tidal wave when the telephone operator at Block Island, Rhode Island, received a call for help from a family marooned in a cottage.

"I was in the telephone office," says installer repairman Robert A. Gillespie, "when I heard of the call. I'd been through hurricanes before and I knew they might be in real trouble."

Quickly enlisting the aid of two men who were outside the telephone building, he drove his company truck to within 400 feet of the isolated cottage, as near as the high water would allow.

"We could see that three poles led toward the cottage," says Bob Gillespie, "so we took handlines and a rope from the truck. We secured one end of the line to the first pole and waded to the second pole. There we tied up our line and kept wading to the third pole."

But they were still thirty feet away from the marooned family when they got as far as the rope would go—thirty feet of dangerous, rushing water.

Bob Gillespie's companions safeguarded the ropes while he fought his way alone to the cottage.

He made three trips through the rising tidal waters. First he carried a small boy to the comparative safety of the forward end of the rope.

Then, with considerable difficulty, assisted two women; and a man and another boy. And finally, though almost exhausted, he guided the entire group along the all-important rope lifeline that led to high ground and safety.

RESCUE AT HAND. Telephone man fights his way through swirling waters to bring marooned cottagers to safety during hurricane.

HELPING HANDS—*The spirit of service of telephone men and women is shown not only in the dramatic situations of fire and flood and storm, but in the everyday affairs of life. Thousands of times every day, and through the long hours of the night, the telephone and telephone people help those who are ill or in trouble or confronted by some occasion that needs a skilled and willing hand. Just having the telephone close by gives a feeling of security and of being close to people.*

BELL TELEPHONE SYSTEM

LEWYT CDT* restricts false targets to one in ten thousand

In the deadly serious task of identifying targets with unmatched accuracy...this compact "brain" carefully screens and interprets radar pulses at the rate of 161,800 per second. Automatically separating interference from true target data, it converts this crucial information into signal form for transmission over telephone wires to coordinating control centers.

Lewyt engineered and built into this data handling equipment the monitoring and sensing features that will provide continuous unfailing operation. Such reliability will contribute materially to the effectiveness of our overall air defense system.

Conceived by the Air Force and developed in close cooperation with M.I.T.'s Lincoln Laboratories...CDT is another example of Lewyt's engineering skill and resourcefulness in the application of the most advanced electronic techniques.

A brochure of other case histories is available by writing: LEWYT MANUFACTURING CORPORATION, Department S-5, Brooklyn 11, N.Y.

**Coordinate Data Transmitter System*

LEWYT

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BPA

SIGNAL

Communications-Electronics-Photography
Journal of the Armed Forces Communications and Electronics Association

VOLUME 10 MAY-JUNE 1956 NUMBER 5

10th Annual AFCEA Convention Program Issue

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Cover by William Robinette

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Authors are entirely responsible for opinions expressed in articles appearing in AFCEA publications, and these opinions are not to be construed as official or reflecting the views of the Armed Forces Communications and Electronics Association.

toward Intercontinental TV

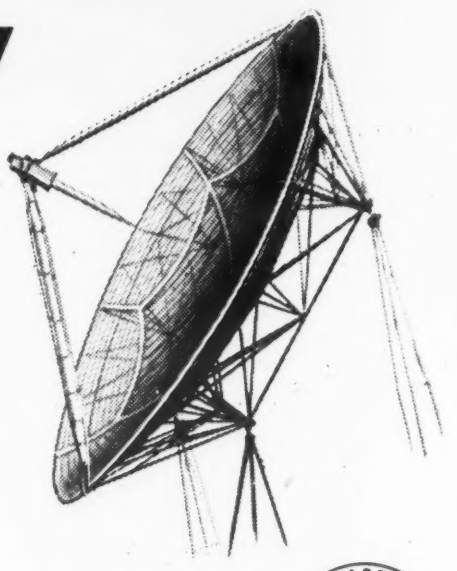
An important advance has been made in microwave radio! It's called "over-the-horizon" transmission.

Until recently, microwave was limited to line-of-sight distances, signals being beamed directly from one antenna right at another. However, engineers knew that a small part of the signal "drops off" the beam, or is "scattered" in the troposphere. A whole new concept was visualized, requiring new, specially-designed equipment.

Now, with the new technique, the signal is beamed far out over the horizon with tremendous power. Huge new "high-gain" antennas capture the "scatter," and a special IT&T electronic system keeps the signal steady for highly reliable communications.

Thus "over-the-horizon" transmission promises to span truly long distances... a big step toward the day when TV may cross the oceans. For telephone and telegraph, facsimile, and telemetering, great benefits can be made available today.

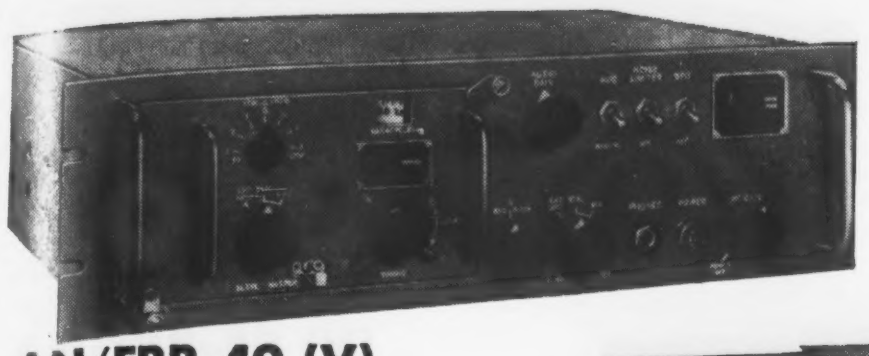
IT&T engineers were the first to introduce microwave communications, 25 years ago. And, by the development of unique equipment, they have made a major contribution toward making "over-the-horizon" microwave commercially practicable.



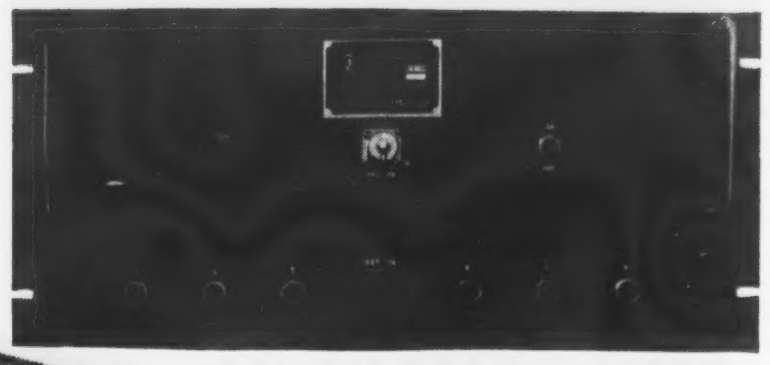
INTERNATIONAL TEL ... TEL

IT&T

INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION, 67 Broad Street, New York 4, N. Y.



AN/FRR-49 (V)
AN/FRR-502
MODEL FFR **COMMUNICATIONS RECEIVER**
Bulletin S-124



AN/CU 5013 ( )/SRR
MODEL AMC-6 **ANTENNA MULTICOUPLER**
Bulletin S-155A

VARIABLE FREQUENCY OSCILLATOR (Direct Reading)
Bulletin S-134A

O/330
MODEL VOX Series 2

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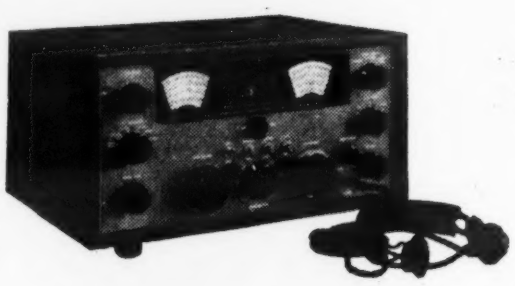
Although TMC products are commercially designed, many have been accepted and nomenclatured by the services for their use without change.

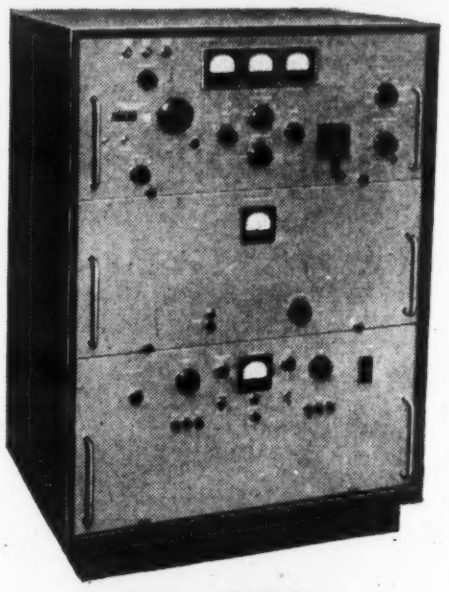
This is due primarily to clean, imaginative design, geared to operational requirements, but secondarily to the fact that the units are built to rigid specifications and from the same family of parts which can be easily supported from a logistic standpoint. Parts peculiar are kept to a minimum. TMC products represent the latest and best in the state of the art in their respective fields and the customer is assured of our continued efforts in this direction.

COMMUNICATIONS RECEIVER (General)



GPR-90
Being Considered
Bulletin S-179B

COMMUNICATIONS TRANSMITTER



GPT-750
Being Considered
Bulletin S-174

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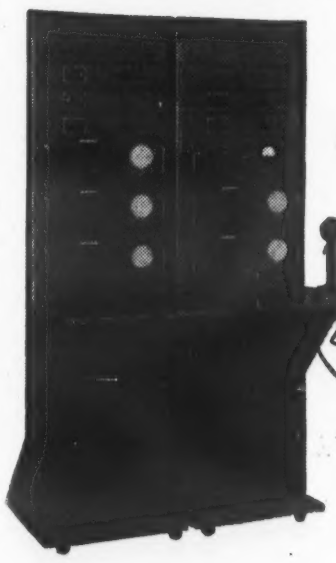
BOOTH 36
AFCEA SHOW

Full, detailed information of each of these products are available in special Sales Bulletins. The Bulletin number appears with each item—just write.

CONTROL TERMINAL



AN/FRA-19 (V)
AN/FRA-501
MODEL RCR

REMOTE CONTROL SYSTEMS
Bulletin S-124B

AN/FRA-19 (V)
AN/FRA-501
MODEL RCR

REMOTE TERMINAL

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MAMARONECK, N. Y.

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Dependable performance is a quarter-century tradition at Motorola—
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Under subcontract to Convair, Motorola *engineered for reliability*, and
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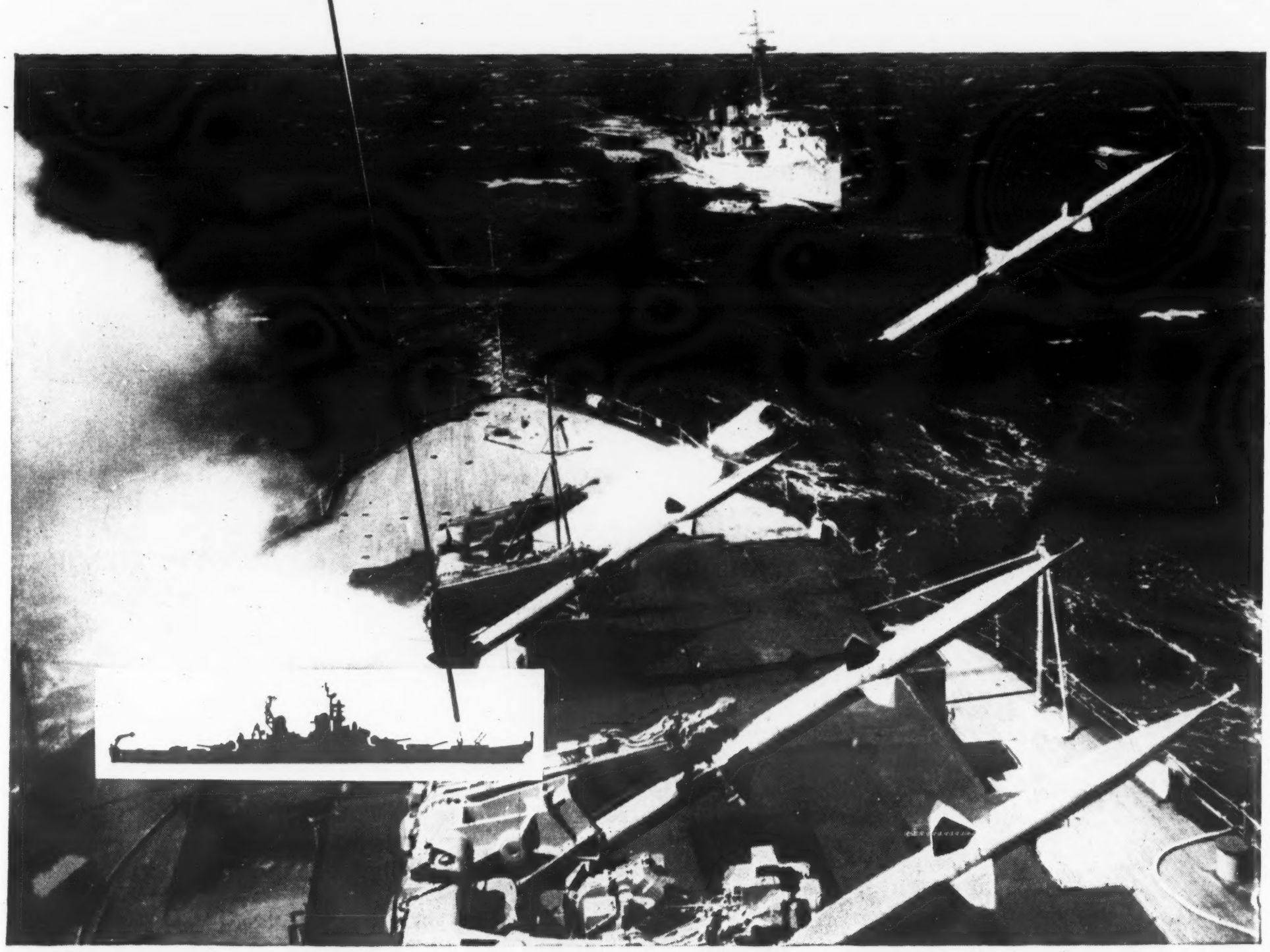


★ Welcome ★ to the ★ 10th Annual ★ AFCEA ★ Convention ★ and Exhibits ★

May 24, 25, 26

Boston

Hotel Statler Headquarters:

Exhibits: 1st Corps Cadet Armory

Military & Industry: Partners in Progress

10th Annual AFCEA Convention

AFCEA President 1954-1956

Greetings from

AFCEA National President

George W. Bailey

To all my fellow members and our many guests, I extend a hearty welcome to the 10th Annual AFCEA Convention. To those who are not able to be with us in Boston, my greetings and best wishes on this historic occasion.

It is indeed significant that we meet on the 10th anniversary of the Association's founding to reaffirm our belief in the purpose for AFCEA's establishment—to encourage a firm and lasting partnership between military and industry. The theme of this year's convention is well phrased, because through this cooperative relationship great things have been achieved in the past, and our progress in both the immediate and distant future is dependent upon the continuation of this mutual respect and understanding.

Your convention committee has arranged a splendid program. They have assembled as our speakers men who feel every pulse of this military-industry relationship.

This year, for the first time, our convention includes individual exhibits. The enthusiastic response to our announcement of the availability of space for our industrial friends is an indication that this new feature is a success, and we expect that it is to be continued at future conventions. The exhibits are located in the 1st Corps Cadet Armory, just across the street from the Hotel Statler. Since they feature military adaptations of communications and electronic equipments and components, all our members will find them interesting and instructive.

At the close of my two years as President, I wish to express my deep appreciation to my fellow officers, the board of directors, the chapter officers, our office staff, and all our members for their splendid support in furtherance of the progress of our Association.

George W. Bailey

Military & Industry: Partners in Progress

Wilbur M. Brucker
Secretary of the Army

To the members of the Armed Forces Communications and Electronics Association, I extend greetings and best wishes for a successful tenth annual convention. Throughout the years since its establishment, your Association has contributed immeasurably to our national defense effort.

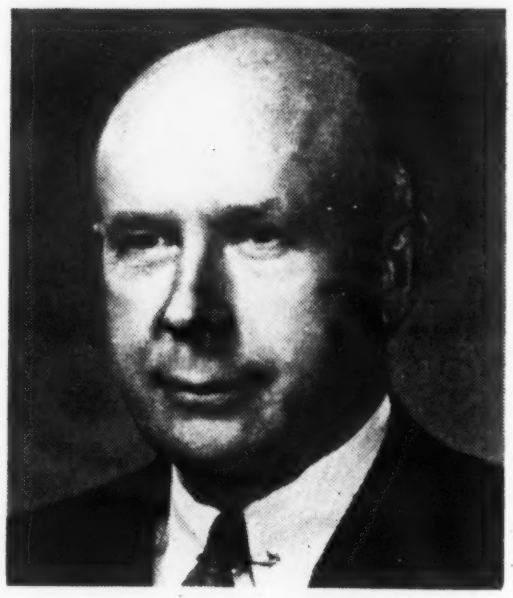
In adopting this year's theme, "Military and Industry: Partners in Progress," you have reaffirmed the invincibility of this traditional alliance which has played a major role in carrying our Nation to victory in three wars. I know that in the uncertain years ahead this indispensable combination, of which your Association is a part, will continue to meet successfully every challenge to the security of our beloved America.

Wilber M. Brucker.

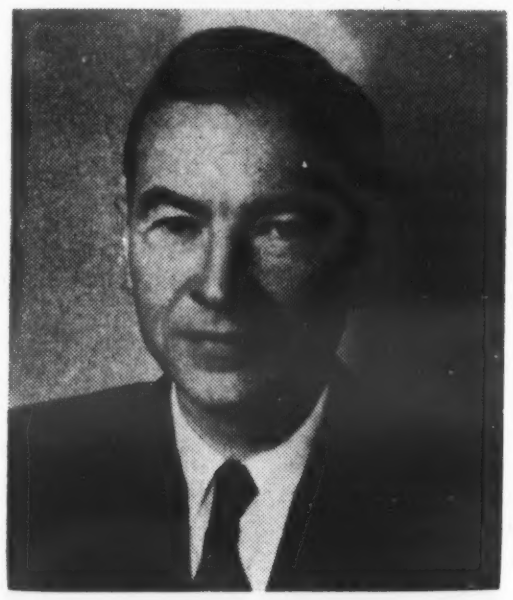
On behalf of the Navy and Marine Corps, I acknowledge with appreciation the vital contributions of the communications and electronics industries toward our state of readiness today. The challenges of tomorrow in these increasingly important fields can be met only by the highest degree of understanding and cooperation in our mutual problems.

This "Partnership in Progress" between industry and the military services is nowhere better exemplified than in the membership of the Armed Forces Communications and Electronics Association. I extend greetings to its members, and best wishes for a successful national convention in 1956 and for continued success in future years.

Charles S. Thomas



Charles S. Thomas
Secretary of the Navy



Donald A. Quarles
Secretary of the Air Force

I appreciate this opportunity to greet my many friends in the communications-electronics field, and look forward to being with you at the annual convention in Boston.

Because this industry is a key component in our structure of national defense, it is vital to our security that both sides of our military-industrial partnership gain a thorough understanding of one another's requirements and capabilities. Only a healthy, resourceful, and aggressive industry can design and produce the reliable and compact equipment demanded in our modern weapon systems.

This is a challenge we must meet in order to maintain our world position in air power. We of the Air Force have every confidence that the skilled men and women and experienced leaders of the communications-electronics industry will carry out their share of this job.

Donald A Quarles

10th Annual AFCEA Conve

Program of Events

Statler Hotel

Thursday, May 24	Activity	Place
9:00 AM - Midnight	Registration	Mezzanine
9:30 AM	Meeting of AFCEA Chapter Presidents	Hancock Room
12:30 PM	Keynote Luncheon	Bay State Room
2:30 PM	Forum on Research	Bay State Room
6:00 PM	Get-Together Reception	Parlors A, B & C
7:00 PM	Informal Dinner	Georgian Room
Friday, May 25		
9:00 AM - Midnight	Registration	Mezzanine
9:30 AM	Meeting of AFCEA Board of Directors and National Council	Parlors B & C
2:30 PM	Forum on Military-Business Relations	Ballroom
6:15 PM	Reception	Ballroom Foyer
7:15 PM	10th Annual AFCEA Banquet	Ballroom
Saturday, May 26		
9:00 AM - 1:00 PM	Tour of Laurence G. Hanscom Field, Air Force Cambridge Research Center, Bedford, Mass.	Buses leave from hotel entrance on Columbia Ave.

Exhibits — 1st Corps Cadet Armory

(Open to all registered Convention-goers and lady guests)
Thursday and Friday, 9:00 AM - 6:00 PM; Saturday, 9:00 AM - 1:00 PM
Registration facilities at Armory

Special Ladies Activities

Thursday, 12:30 PM Luncheon Veranda

The Ladies Hospitality Room, 4th Floor, will be open Thursday and Friday, 9:00 AM to 5:00 PM, with coffee served each day from 9:00 AM - 11:00 AM.

Tours to points of interest in the Boston area have been arranged for the mornings and afternoons of Thursday and Friday. Tickets are available at the Registration Desk.

The ladies are cordially invited to attend the Convention evening activities with their husbands.

Press information available in the Hancock Room, 9:00 AM - Midnight, Thursday and Friday.
See Jack L. Hobby, publicity chairman.

Convention Headquarters—Hancock Room ***Student Headquarters—4th Floor***

vetion — Military & Industry: Partners in Progress

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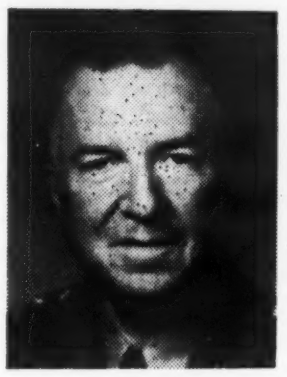
Forum on Research

1. ***Maj. Gen. James M. Gavin, USA***
   Chief, Research & Development
   Office of the Chief of Staff, USA
2. ***Rear Adm. Rawson Bennett, USN***
   Chief, Office of Naval Research
3. ***Lt. Gen. Donald L. Putt, USAF***
   AF Deputy Chief of Staff/Development,
   and Military Director of the Scientific Advisory Board to the Chief of Staff, USAF
4. ***Mr. Albert E. Mignone***
   Director of Research
   Arthur D. Little, Inc.

Moderator: ***George W. Bailey***



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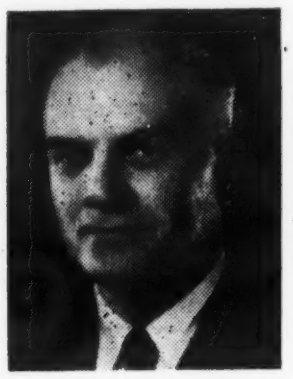

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Forum on Military-Business Relations

1. ***Maj. Gen. James D. O'Connell, USA***
   Chief Signal Officer, USA
2. ***Vice Adm. Edward W. Clexton, USN***
   Chief of Naval Material
3. ***Maj. Gen. Thomas P. Gerrity, USAF***
   Assistant for Production Programming
   Deputy Chief of Staff/Materiel, USAF
4. ***Mr. Frederick R. Lack***
   Vice President
   Western Electric Company

Moderator: ***George W. Bailey***

Keynote Luncheon

Honored guests include:

The Honorable Christian Herter
Governor of Massachusetts

The Honorable John Hynes
Mayor of Boston

Rear Adm. John Snackenberg, USN
Commandant, 1st Naval District Hdqrs.

Maj. Gen. Raymond C. Maude, USAF
Commander, AF Cambridge Research Center

Col. W. W. Heinel, USA
Commander, Boston Army Base

Master of Ceremonies: ***Gardiner G. Greene***
President, AFCEA Boston Chapter, Host Chapter

Gardiner G. Greene

David R. Hull

10th Annual AFCEA Banquet

Featured Speaker: ***The Honorable Donald A. Quarles***
Secretary of the Air Force

Master of Ceremonies: ***Capt. David R. Hull, USN (Ret)***
1956 Convention Chairman

10th Annual AFCEA Convention

Index to Exhibits

1st Corps Cadet Armory • Boston

A.R.F. Products, Inc. ***Booth #30***

*AN/UPM-15 pulse generator; *DA-18/U dummy load; AN/SG-12 signal generator; AN/GRC-10 radio set; OA-249/GRC-10 antenna; AR-1A deviation meter.

See ad on page 71

Air Associates, Inc. ***Booth #9***

The "electronic messenger" is a compact and versatile electro-mechanical communication unit which transmits and receives any printed or written material up to 8½ x 14 inches. It affords management the means of sending and receiving data between branch offices and plants without any chance of costly errors.

Alden Electronic & Impulse Recording Equipment Co. ***Booths #25, 76***

Operating display of facsimile communication systems featuring: Alden high speed selective dispatch system; Alden flat scanner and continuous recorder for large copy; Alden weather map recorder, and Alden giant facsimile bulletin board.

See ad on page 50

American Machine & Foundry Co. ***Booth #64***

Electronic display equipment; silver zinc batteries; relays; fiber film insulation; turbo power supplies.

See ad on page 40

Arma, a division of American Bosch Arma Corp. ***Booths #24, 26***

Exhibit highlights Arma's research and manufacturing capabilities against a background of its contributions to the Armed Forces. Featured are "all around" bomber defense, "all weather" systems, and the division's advanced position in the field of inertial guidance. Products displayed illustrate 35 years of progress by Arma.

Automatic Electric Sales Corp. ***Booth #41***

Automatic Electric's relays and rotary stepping switches form the "brains" of the Signal Corps' new AN/FGC-30 central office teletypewriter switching center, large enough to have its own automatic telephone exchange. See the April *Fortune* cover and automation article for a good look at these components in another application.

See ad on page 73

Berkshire Laboratories ***Booth #6***

Miniature pulse transformers, new PT-100 encapsulated unit, Noval miniature socket plug-in, four windings; complete blocking oscillator plug-in unit; Berkshire Labmarker for cathode-ray oscillography—generates timing marks from sinusoidal input; alertness indicator for electro-physiological studies.

Bomac Laboratories, Inc. ***Booths #35, 37***

Gas switching tubes, TR-ATR and Pre-TR; dual TR and ATR tubes; silicon diodes; waveguide switches; reference cavities; magnetrons; pressurizing windows; shutter tubes; hydrogen thyratrons; reflex klystrons; traveling wave amplifier tubes; systems.

See ad on page 14

Burroughs Corp. ***Booths #43, 45, 47***

*Demonstration of Burrough's electrographic printing and plotting technique; electronic and electromechanical communications equipment; beam switching tubes; *indicator tubes—"Pixie" and "Nixie"; *Vari-Count pulse control equipment; magnetic components; cores and pulse transformers; "Beamplexer" (a ten-channel electronic switch).

Capitol Radio Engineering Institute, Inc. ***Booth #33***

CREI home study courses in radio, electronics and television engineering.

See ad on page 22

Craig Systems, Inc. ***Booth #72A***

Mobile electronic systems, air traffic control towers; shelters, vans, trailers, missile carriers; reusable containers for electronic components; airplane parts and optical equipment; tropospheric-scatter antennas; antennas; masts, and insulated boxes.

See ad on page 89

Diamond Microwave Corp. ***Booth #55***

*Antenna systems; *feeds; *rotary joints; *ridged horns; *gain horns; *receiving horns; *high power diplexers; adapters; attenuators; crystal mounts; directional couplers; duplexers; *filters; frequency meters (coaxial and cavity types); klystron mounts (and oscillator cavities); line stretchers; *loads; magic tees, and many other products.

Allen B. DuMont Laboratories, Inc. ***Booth #72***

Exhibit features new daylight-viewing universal indicator tube, hermetically sealed with integrated power supply; universal camera control system, a series of plug-in type units which operate camera automatically for aerial reconnaissance, and a variety of special tubes including multi-gun, photo-multiplier, image-converter and storage tubes.

See ad on page 97

Electomic Mechanisms, Inc. ***Booth #49***

*Electro-mechanical amplifier—a reversible proportional torque control which eliminates power amplifier and replaces the servo motor and reduction gears. *Powdered iron clutches; *powdered iron brakes; *powdered iron brake-clutch.

Electro-Devices Co., Inc. ***Booth #20***

*Coilwinder specifically for winding miniature toroids will wind wire sizes from #30 down to #46 minimum I.D. 093, maximum O.D. 1 inch. No sliders — simple polished shuttle—unique principle. Simplicity of this machine is a revelation.

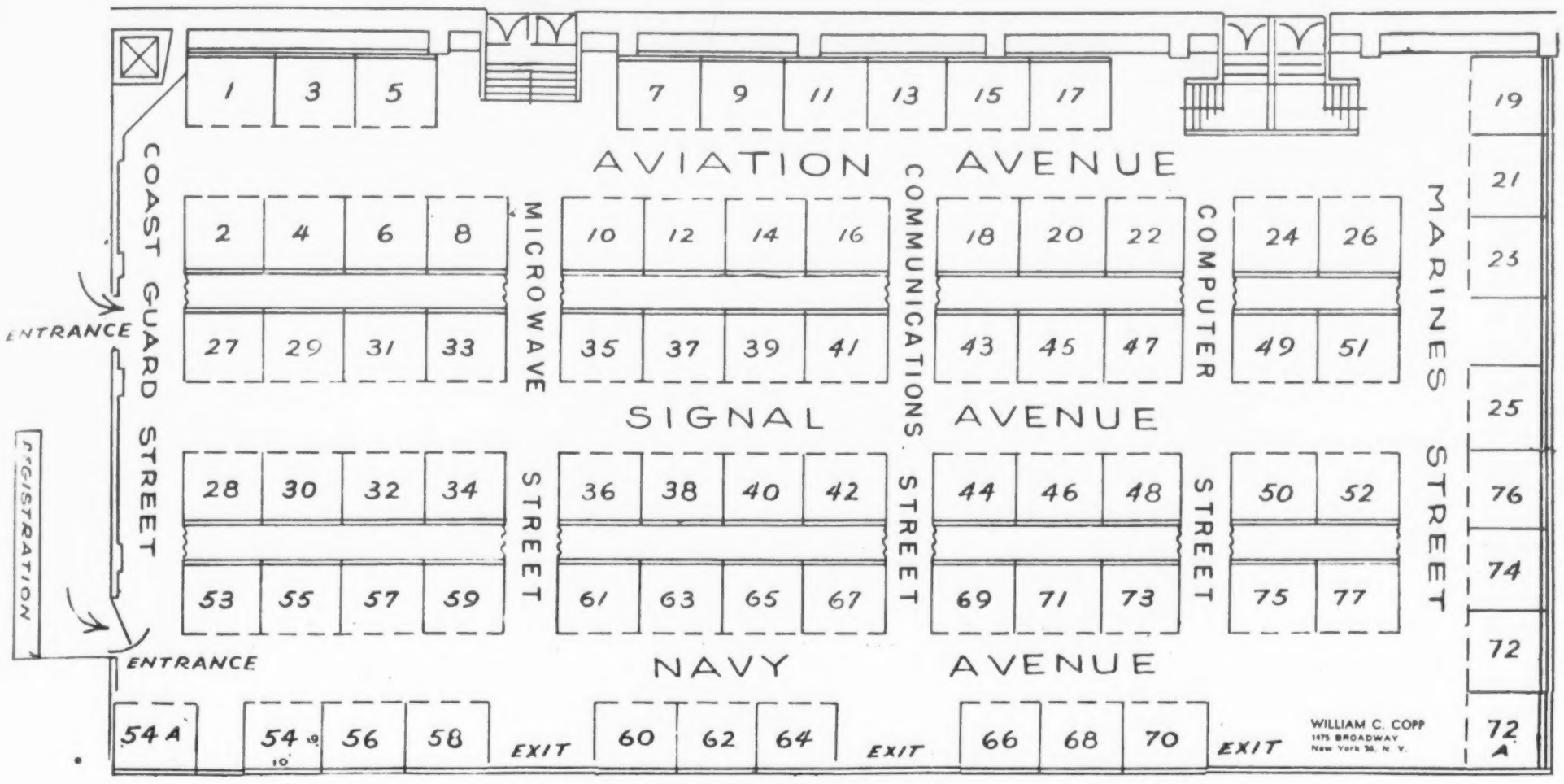
Elgin Metalformers Corp. ***Booths #63, 65***

Typical assemblies and individual pieces selected from the EMCOR Modular Enclosure System, a system of cabinets and consoles that enables engineers to "tailor-make" their own enclosures from standard, mass-pro-

(*Continued on page* 15)

***Indicates new product.**

Map and Location of Exhibits



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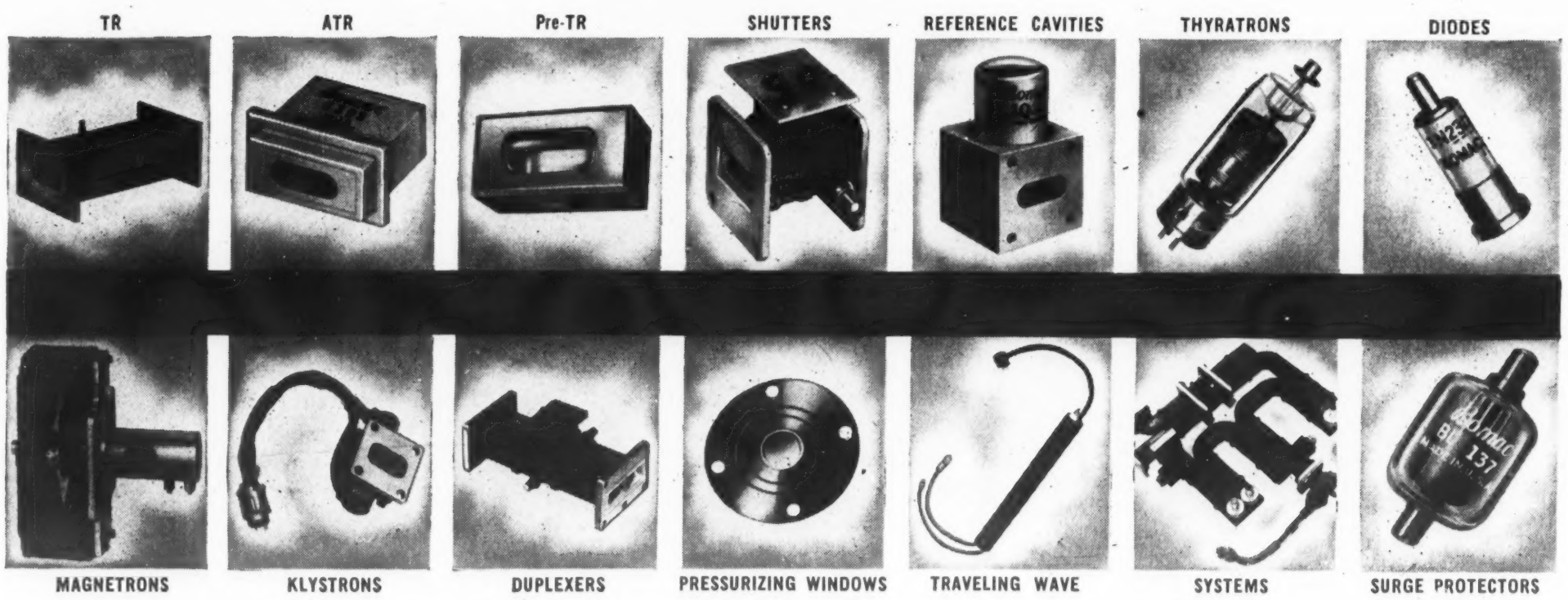
meet us on this corner at the AFCEA show

MICROWAVE STREET

[redacted]

SIGNAL AVENUE

We'd like to see you. Our complete line of microwave tubes and components will be on display, and some of our top engineering specialists will be there to tell you about them. If you have a particular problem, in this field, come over and discuss it with us. On our staff are some of the country's leading tube specialists, and our engineering and production facilities are unmatched.



Bomac Laboratories, Inc.

BEVERLY, MASSACHUSETTS

Positions are open for both junior and senior engineers for design and development work on microwave tubes. The work is challenging, advancement opportunities unlimited, and benefits liberal.

Offices in major cities:—Chicago • Kansas City • Los Angeles • Dallas • Dayton • Washington • Seattle • San Francisco • Toronto **Export:**—Maurice I. Parisier, 1860 Broadway, N.Y.C.

Exhibits

Continued from page 12)

duced items available from stock and combining highest quality, excellent delivery and substantial savings.

Fairchild Camera & Instrument Corp. ***Booths #75, 77***

Reconnaissance and precision mapping cameras used in gathering intelligence data; precision potentiometers and pressure transducers with potentiometer output, used in missile control systems, fire control systems, auto pilots, radar equipment, air data computers, nuclear instrumentation systems and equipment; motors.

Federal Telecommunication Laboratories ***Booth #15***

Aircraft guidance systems: Tacan; Navaglobe-Navarho; silicon rectifiers; electron tubes.

See ad on page 59

Federal Telephone & Radio Co. ***Booth #17***

Communications and aerial navigation equipment; Tacan, both military and commercial applications; ground radio communications; microwave communications, and ground-to-air systems; Loran instrument landing systems and components.

See ad on page 86

Gabriel Electronics Division, The Gabriel Co. ***Booth #11A***

Parabolic microwave antennas 940-1300 mc; omnidirectional mobile base antennas; directional communications antennas; ground-based and aircraft radar communication missile telemetering antennas.

The Haloid Co. ***Booths #57, 59***

Xerography, a dry direct positive process used in copying anything written, printed, typed or drawn. This versatile process can be used for making offset diazo spirit masters for copying. Also can be used in producing printed circuitry.

Homelite, a division of Textron American, Inc. ***Booth #39***

Featuring representative models of light-weight gasoline-engine-driven generators designed to meet the latest military specifications. Also, one of the acoustic housings available for these sets. The display includes a motor-driven cutaway model of a typical engine-driven set showing internal construction.

Hughes Aircraft Co. ***Booths #1, 3***

Featuring a demonstration of an electronic scan radar which provides three-dimensional target data from a single antenna transmitter and receiving channel; electron tube demonstrations including the Memotron direct display storage tube with the ability to retain tracings indefinitely and the Tonotron which is a new high intensity, long persistence tube.

Hycon Eastern, Inc. ***Booth #52***

Working model effectively demonstrating beyond-the-horizon "scatter" transmission for long-range communications systems; crystal filters at any frequency between 10 kc. and 30 mc. with band-width limits from .01% to 10% of center frequency; ultra-stable crystal controlled oscillators with long time stability of 1 part in 10^9 per day.

See ads on pages 18, 19

Information for Industry, Inc. ***Booth #54A***

*Uniterm index of United States electronics patents.

Institute of Radio Engineers ***Booth #70A***

Proceedings of the IRE; IRE Directory.

See ad on page 133

D. S. Kennedy & Co. ***Booth #58***

Exhibiting scale models of 28-foot and 60-foot radio telescopes, 60-foot tracking antenna and 28-foot "scatter antenna systems."

Kleinschmidt Laboratories, Inc. ***Booth #46***

Airborne teletypewriter set AN/-AGC-1 provides air-air, air-ground, and ground-air communications. Features include selective calling, recording and storage of all messages. The teletypewriter set AN/TGC-5 (for torn tape operation) consists of two reperforators, two transmitters, and facilities for automatic channel numbering.

Lewyt Manufacturing Corp. ***Booths #27, 29***

Electronic, electro-mechanical and mechanical products for all branches of the Armed Forces.

See ad on page 2

Microwave Associates, Inc. ***Booth #60***

Manufacturers of silicon diodes; magnetrons; waveguide components and test equipment; TR and ATR switch tubes; reference cavities; waveguide pressure windows.

Motorola Communications & Electronics, Inc. ***Booth #2***

*New line of portable 2-way radio equipment; "handie-talkie"; "handie-talkie" radio pager; *Motorola power transistors; unclassified military units.

See ad on page 6

Mycalex Corporation of America ***Booth #53***

SUPRAMICA 555 (precision molded) and SUPRAMICA 500 (compression molded) ceramoplastic insulations featuring total dimensional stability, resistance to temperatures as high as 900° F., excellent dielectric properties and radiation resistance. MYCALEX 400 and MYCALEX 410 glass-bonded mica insulating materials for high temperature, high frequency applications.

See ad on page 49

New England Telephone & Telegraph Co. ***Booths #5, 7***

Visualization of the part the Bell System plays in communications and electronics for Armed Forces. A photo-montage background showing Armed Forces using telephone products. Miniature two-way working microwave demonstration. Component parts of a microwave receiver and transmitter. Historical display of field telephones.

North American Aviation, Inc. Autonetics Division ***Booths #19, 21, 23***

Fire control and computer equipment. The fire control display includes prediction and ballistic computers and features a motion picture showing the equipment in action. The computer display features both general purpose computers and airborne digital differential analyzers. Other product lines, such as guidance systems, flight control systems.

Penn Precision Products, Inc. ***Booth #74***

Precision-rolled, ultra-thin strip; beryllium copper, phosphor bronze, nickel silver, brass OFHC copper, stainless type 17-7PH, chromium copper, invar, magnetic materials (49 & 80% nickel).

Philco Corp. ***Booths #32, 34***

Philco's Government & Industrial Division, TechRep Division and Electronic Tube and Transistor Division exhibit sub-miniaturized M-1 transistors, surface-barrier transistors (SBT), industrial television, TRANSAC transistorized computer, and TechRep services.

See ad on page 93

Stanley B. Pierce ***Booth #13***

Representing:

Audio Development Co.
Augat Brothers, Inc.
Daven Company
Hardwick Hindle, Inc.
Nugent Electronics
James Vibrapowr Company

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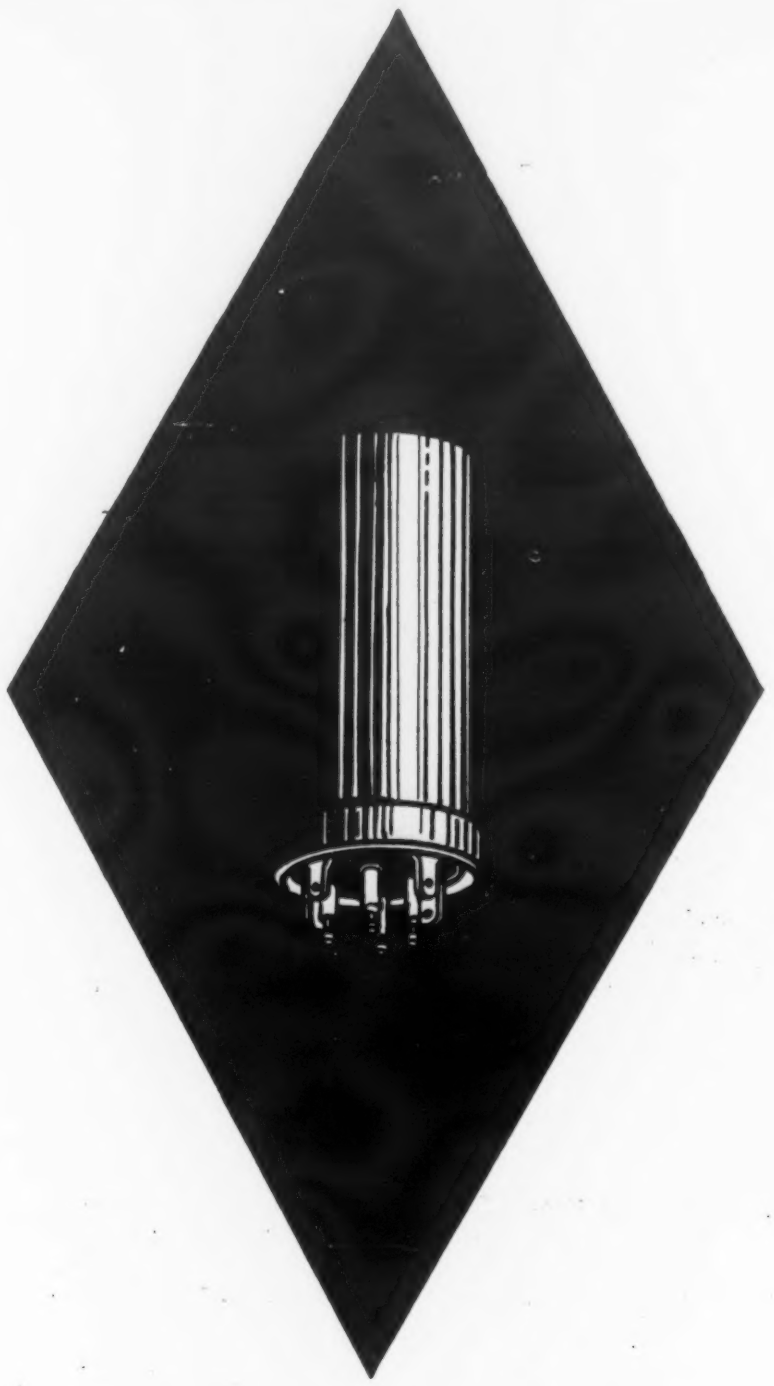


EXTENDED LIFE ELECTROLYTIC CAPACITORS

now available for

military electronics
computers
laboratory test instruments
industrial controls
other electronic applications

HERE ARE CAPACITORS OF THE SAME *MAXIMUM RELIABILITY* which Sprague has long supplied to the telephone systems . . . now available for your own high reliability electronic applications.

The use of especially high purity materials . . . utmost care in manufacture, constant observation and quality control of all operations have made Sprague Extended Life Capacitors outstanding for their long life and faultless performance.

Type 17D Extended Life Electrolytics have turret terminals and twist-mounting lugs. A special vent construction is molded right into the cover, as are the numbers identifying each terminal. The aluminum cans are covered with a corrosion-resisting insulating coating.

Nineteen standard ratings, all characterized by low maximum leakage current and remarkable life test capabilities are available in the new series. Complete technical data are in Engineering Bulletin 340, available on letterhead request to the Technical Literature Section, Sprague Electric Company, 287 Marshall Street, North Adams, Massachusetts.

SPRAGUE® *world's largest capacitor manufacturer*

Export for the Americas: Sprague Electric International Ltd., North Adams, Massachusetts. CABLE: SPREXINT.

Exhibits

(*Continued from page* 15)

Radio Corporation of America
Booths #69, 71, 73

Communications; military TV; counter measures; audio systems; information handling; radar; fire control; missile systems; Loran; Shoran; infra-red systems; electron tubes for military application. Government service facilities.

See ads on pages 23, 44, 80, 91

Radio Engineering Products, Ltd.
Booth #38

4 and 12, and 24 and 72 channel telephone carrier systems for multiplexing on radio systems; military mobile communication centers providing complete facilities for communication by telephone and teleprinter, including telephone switchboard, teletype operations, cipher carrier radio and diesel power equipment.

See ad on page 122

Railway Electronics, Inc.
Booth #40

Portable bias and distortion meter is ". . . the most valuable of all tools for the technical supervision of transmission . . ." Direct meter readings indicate the percentage of bias and distortion in circuits without interrupting message traffic. Universal adaptability, start-stop and synchronous systems, single current and polar signal circuits, teletypesetter and computer circuits.

See ad on page 82

Ramo-Wooldridge Corp.
Booth #50

General research and development services.

Raytheon Manufacturing Co.
Booths #54, 56

*Silicon transistors and diodes; germanium transistors and diodes; silicon power rectifiers; reliable miniature tubes and subminiature tubes; recently declassified magnetrons; *wave-guide klystrons; microwave communication marine radar; marine radar; marine radio direction finder, and new line of panel components.

See ads on 4th cover, 69, 70

Remington Rand, Division of Sperry Rand Corp.
Booths #66, 68

The Univac Division features a 1/12 scale model of the Univac system used by many Government agencies. This model presents a brief recorded transcription of Univac and each of its components. There are also displayed magnetic core matrices, antenna couplers, and printed circuit packages.

Revere Corporation of America
Booth #31

Wires to military and industrial specifications, including PERMACODE (extruded DuPont teflon) hook-up wire for 210° C. continuous use, REVCOTHENE for inertness, chemical resistive and extended temperature use, and a variety of thermocouple wire constructions. Hermetically sealed magnetically operated GLASWITCH and new miniature relays.

Skydyne, Inc. ***Booth #42***

Design, development and production of transit cases and reusable containers specifically designed for mobile and field electronic instruments using sandwich material or molded Fiberglas material. Included in the design is shock isolation medium, compartmentation and special fixtures, as required, for accompanying tools, spare parts and cables.

See ad on page 112

The SoundScriber Corp.
Booth #4

*Long-time magnetic tape recorder —continuous recording from 1 min. to 24 hrs., no tape change; *magnetic tape bulk erasure equipment; *4-8 hr. recorder completely remote control, less than 1/3 of a cubic foot in size.

Star Expansion Products Co.
Booth #70

Tube pin straighteners for miniature and sub-miniature tubes; socket wiring plugs for miniature and subminiature sockets. Especially talk to us about our new JE-20 dual tube pin straighteners for subminiature round base and pinch base tubes.

Stelma, Inc. ***Booth #28***

Multichannel telegraph monitor — automatically scans ten telegraph channels and gives automatic warnning when circuits are deteriorating; telegraph distortion analyzer TDA-2, electronic 2 wire repeater, electronic relay, transistorized tone keyer, regenerative repeater, DC isolation keyer, half duplex-full duplex DC repeater, electronic.

See ad on page 115

Sylvania Electric Products, Inc., Electronic Systems Div.
Booth #11

Display includes radar altimeters; communications equipment; packaging technique for electronic components, test equipment, electronic headlamp dimmer, and *ferrite display console.

Tech Laboratories, Inc.
Booth #22

For over twenty years, Tech Laboratories has been a leading manufacturer of attenuators, instrument switches, stepping switches, resistance measuring test equipment, special electronic control equipment, and special timers. See our new stepping switches which are built on the ruggedness, long life and low price of our type 2A switches.

Technical Materiel Corp.
Booth #36

*New HF communications station consisting of 1 KW transmitter; remote control amplifier; communications receiver; FS transmitting and receiving equipment; high stability oscillator; antenna multicoupler, and various antenna terminating units.

See ad on page 5

Technicraft Laboratories, Inc.
Booth #44

In addition to a complete line of rigid and flexible waveguide assemblies and components, Technicraft features its new line of *broad band double ridged wave guides and components. These include rigid and flexible wave guides; bends and twists; power dividers; wave guides to coax transitions; slotted lines.

See ad on page 126

Teletype Corp. ***Booths #14, 16***

*Teletype 28 printer; enlarged model of the Teletype all-steel clutch; enlarged model of the type box and printing mechanism, and demonstration of how the Teletype 28 printer operates at 100 words per minute in any position.

Times Facsimile Corp. ***Booth #61***

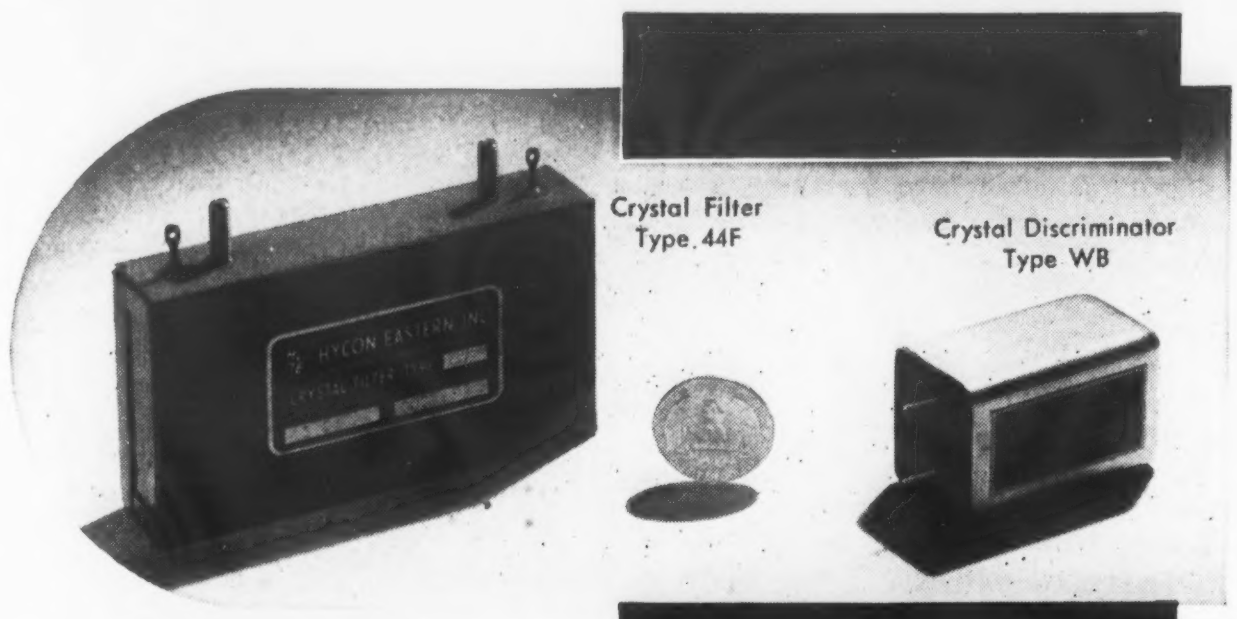
Model PJ Weatherfax recorder operating on WAN network features automatic unattended recording of weather charts. Other applications include precision depth recording and data recording at speeds up to 30 scans per second. Also Stenafax — the modern electronic machine for automatically making offset masters and mimeograph stencils.

See ad on page 85

Tower Construction Co. ***Booth #48***

Radio towers for military use; rhombic antenna towers; microwave towers; microwave passive reflectors; microwave buildings; *28′ dia. parabolic antennas for forward scatter;

(*Continued on page* 18)



for FM Reception by

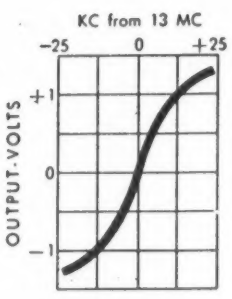
Through the use of Piezoelectric resonators, filters are now available with extremely high selectivity at frequencies which eliminate the need for multiple conversions in VHF and UHF f-m receivers. The low insertion loss, linear transfer characteristic and non-microphonic quality of these filters permit their location at any point of low signal level such as between the mixer and the i-f amplifier. Using the Hycon Eastern Crystal Discriminator, Type WB, in combination with Crystal Filter Type 44F completely eliminates the need for any lower intermediate frequency. These filters can be produced on short notice in large or small quantities to meet *exact* performance requirements.

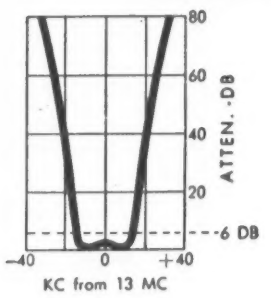
Write for Crystal Filter Bulletin

- SMALL SIZE
- HIGH SELECTIVITY
- LOW INSERTION LOSS
- OPERATING TEMPERATURE: −55°C. TO +85°C.
- EXTREME STABILITY WITH VARIATIONS IN TEMPERATURE. FREQUENCY SHIFT LESS THAN ±.005% TOTAL FROM −55°C. TO +85°C.
- NON-MICROPHONIC
- UNAFFECTED BY IMPEDANCE VARIATIONS COMMONLY ENCOUNTERED IN TRANSISTOR CIRCUITS
- WORKS DIRECTLY TUBE-TO-TUBE OR TRANSISTOR-TO-TRANSISTOR WITH NO PADDING
- HERMETICALLY SEALED, NO ALIGNMENT OR READJUSTMENT NECESSARY
- VIBRATION AND SHOCK PER MIL-E-5422

ELECTRICAL SPECIFICATIONS

Center Frequency 13 Mc (Available 10-20 Mc)
Bandwidth at 6 db Attenuation: 30 Kc (Available with 20-50 Kc Bandwidth)
Shape Factor: $\frac{\text{60 db Bandwidth}}{\text{6 db Bandwidth}} = \frac{1.7}{1}$ Maximum
Power Insertion Loss: 6db Maximum
Passband Response Variation: ± 1 db Maximum
Ultimate Attenuation: 80 db Minimum
Center Frequency Shift: ± 1 Kc





We invite your inquiry for ***any*** *Crystal Filter application in the 10 KC to 20 MC Range*

HYCON EASTERN, INC.
COMMUNICATION FILTER DIVISION
1360 Soldiers Field Road Dept. G-5 *Boston 35, Massachusetts*
Affiliated with HYCON MFG. COMPANY, Pasadena, California

Exhibits

(*Continued from page* 17)

corner reflector towers for forward scatter; erection of radar towers.

See ad on page 107

United Shoe Machinery Corp. ***Booth #18***

Dynasert assembly equipment provides makers of electronic products with semi-automatic inserting machines designed for limited lot production display. Features bench-type axial lead jumper wire and disc capacitor. Automatic multi-station system and other individual machines for varied component insertion.

Vectron, Inc. ***Booth #62***

Contract and sub-contract manufacturer of mechanical, electronic, and electro-mechanical assemblies and equipment. Development and manufacture of specialized photographic equipment. Shoran and radar units, control and plotting devices, and specialized instrumentation.

See ad on page 128

Western Union Telegraph Co. ***Booth #67***

Type 111 communications system featuring priority handling of rush messages, simplicity of operation, compactness, quiet operation, attractive design, automatic numbering, automatic tape feed-out, automatic dual flip-flop transmitters for maximum circuit loading. Also letter-size facsimile equipment.

Westinghouse Electric Corp. ***Booths #10, 12***

HF transmitter exciter and low frequency, very compact transmitter, both continuously tunable and crystal stabilized; "Joysphere," a new method for precise control of spot on an indicator tube; digital sin-cos computer for converting degree angle values into rectangular coordinates and using transistor printed circuit board construction.

Wickes Engineering & Construction Co. ***Booth #51***

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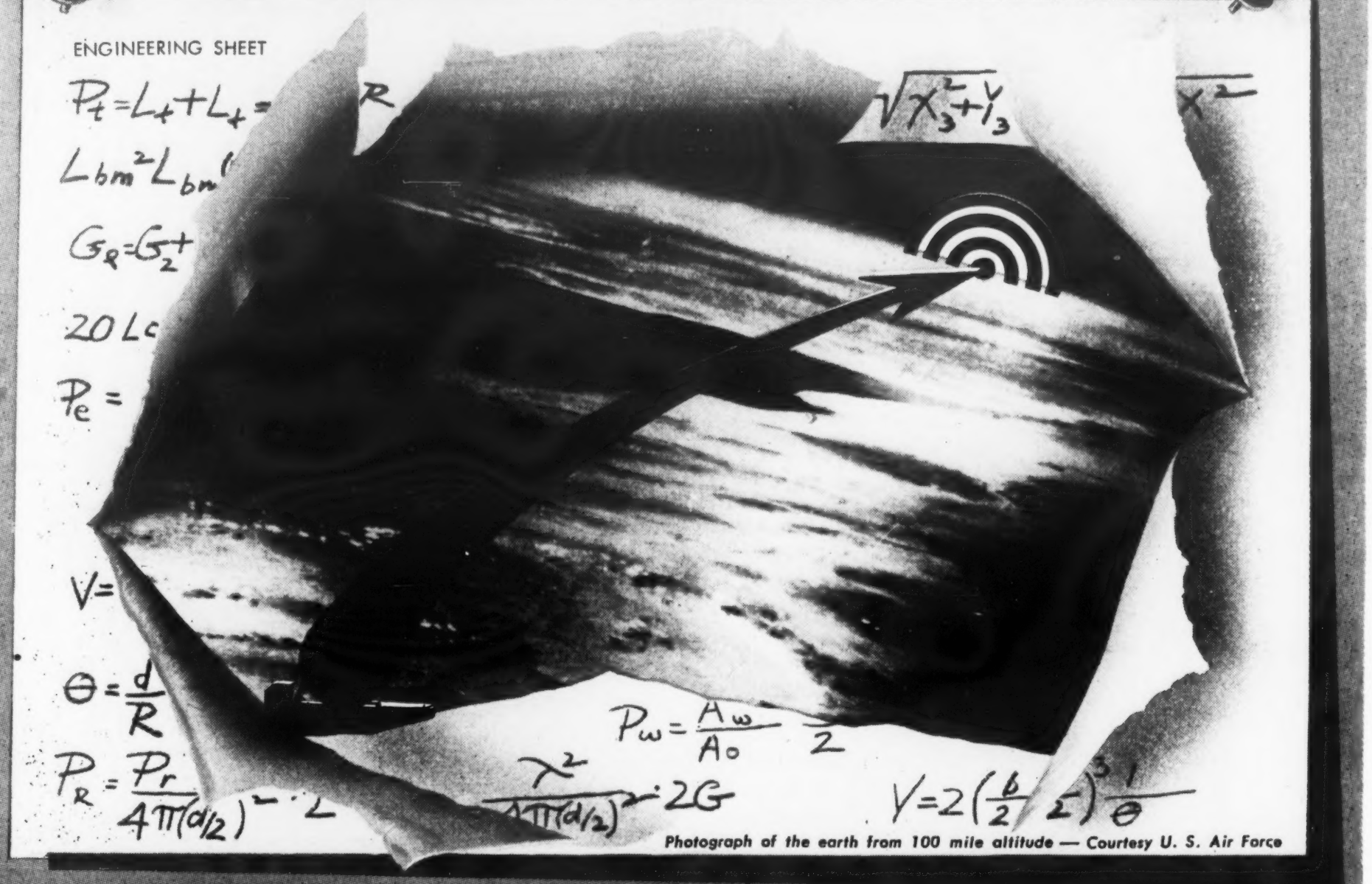
A NEW DESIGN APPROACH . . .



Photograph of the earth from 100 mile altitude — Courtesy U. S. Air Force

. . . BEYOND-THE-HORIZON TRANSMISSION

BEYOND-THE-HORIZON TRANSMISSION

The newest military and commercial long-range communications systems are turning towards the advantages of "scatter" transmission. By transmitting *directly* to stations well beyond the horizon, scatter transmission systems eliminate the construction and maintenance of intermediate microwave stations and avoid cables and repeaters of wire systems, while retaining the wide bandwidths available at high frequencies. This *direct* transmission can span water or inaccessible terrain while giving predictably high signal reliability and freedom from interference.

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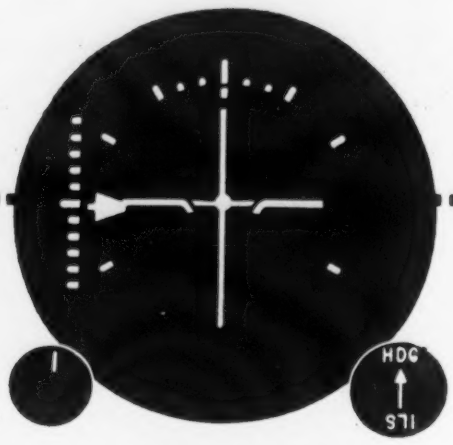

APPROACH HORIZON

Mr. Earl Raymond, Supervisor, Instrument and Electronics, says:

"In 78,198,000 passenger miles, no time has been lost because of unscheduled removals of Collins Integrated Flight System.

"During the period our IFS equipped Viscounts have been in service we have had 751 ILS approaches without a single missed approach.

"We have been thoroughly pleased by the unsurpassed reliability of the components of the Collins Integrated Flight System."

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"Easy to detect pitch and bank errors; easy to cross-monitor; less chance of missetting.

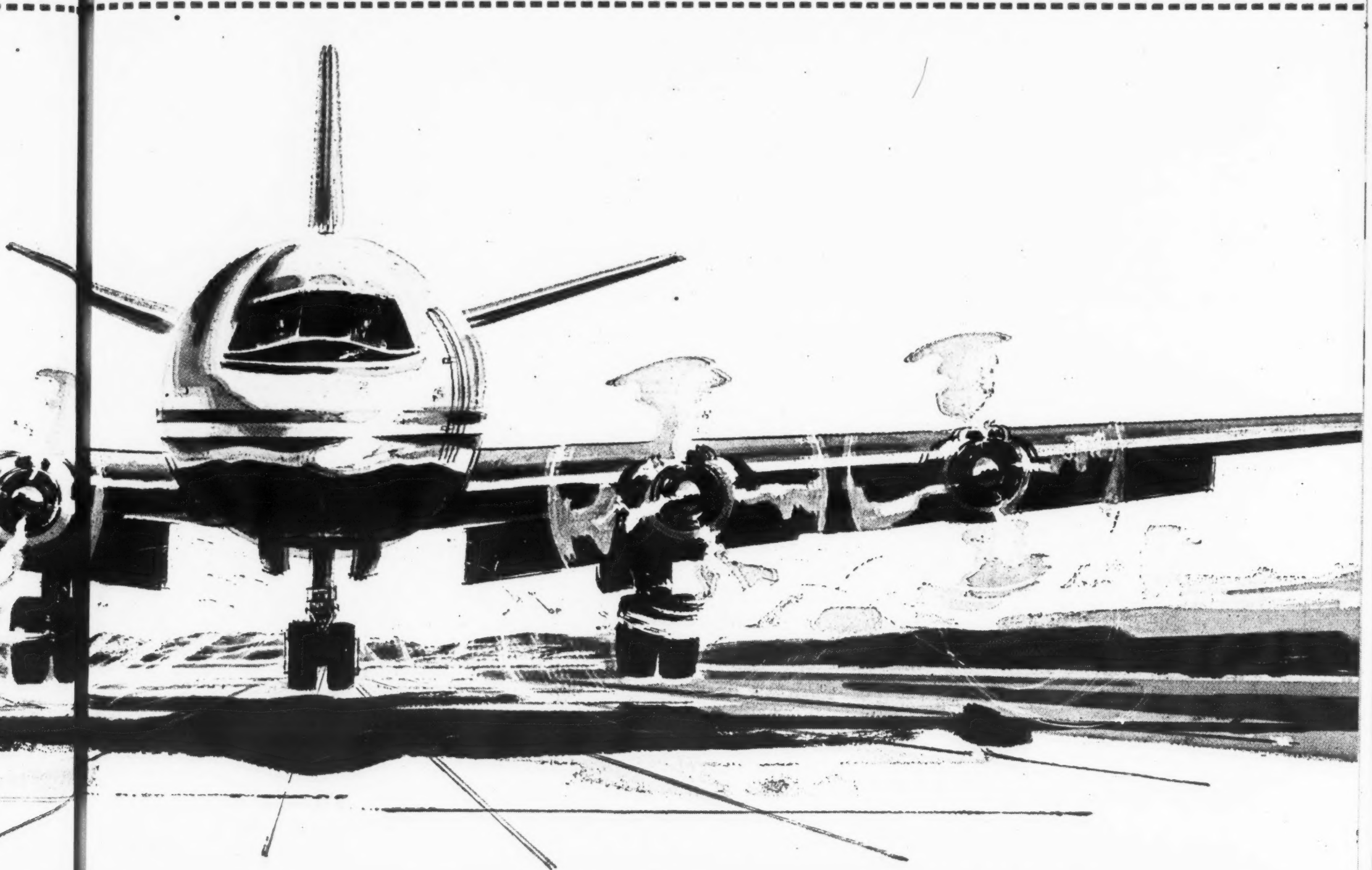
"In heading function, Approach Horizon makes enroute flying less tiring.

"Use of Course Indicator while 'holding' reduces fatigue.

"Automatic cross-wind correction simplifies ILS steering.

"Use of Heading Marker and Steering Needle makes radar flying more precise.

"During training, pilots consistently make more accurate ILS approaches than with previous equipment — definite improvement from the very beginning."



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One of a series of institutional messages

We have been asked — time after time, by all levels of management:

How do CREI Home Study Graduates Compare with its Residence School Graduates?

E. H. Rietzke, *President*

FOR 24 YEARS, Capitol Radio Engineering Institute's residence school has provided industry with a limited number of well-trained men. Such blue-ribbon companies as Bell Telephone Laboratories and Sandia Corporation, Convair and IBM and many others, regularly send recruiters to CREI to interview graduates.

However, another aspect of CREI—the Home Study program—is a rich source of technical personnel who are just as valuable to industry. Here are the facts. We'll tell you our conclusion. You make the decision.

	RESIDENCE SCHOOL	HOME STUDY
Average age of graduates	25 years	26–30 years
Pre-CREI Background	High School, or real equivalent, some with little or no electronics background, but many with years of electronics experience in military or industry.	Professional Electronic experience with at least the equivalent of high school background. 98% are already employed in electronics work at the time they enroll. They range from young technicians to highly experienced engineers, who enroll because they are desirous of upgrading themselves.
Basic texts used	Same CREI for both.	Same CREI for both.
Lab facilities	CREI's modern, fully-equipped laboratory facilities.	Practical day-to-day work in the field takes the place of laboratory work. The subject matter of their studies is applied in their daily duties.
Length of course	3 collegiate years are condensed into 26 months average. Students attend classes 35 hours per week, 48 weeks per year. Virtually all time is devoted to practical engineering subjects, strictly liberal arts subjects being minimized.	Home study students proceed as governed by study habits, ambitions and available time. Average completion time for basic course for a diligent student:—Three to four years. Note: We feel there is something "special" and desirable about a man willing to devote spare hours and evenings to upgrading his technical knowledge and his value to industry. It takes a lot of fortitude to take on and complete a home study program as comprehensive as that offered by CREI.

CREI HOME STUDY STUDENTS at the time of enrollment are already working in industry in a job requiring previous training and experience, many in engineering or supporting engineering capacity—in production, design or testing—right along side of graduates of engineering colleges. Home study graduates are employed in practically every phase of the radio-electronics industry, in posts ranging from technicians to engineers. The list of the companies employing CREI home study students and graduates virtually constitutes the electronics industry.

Here is a partial list of leading companies that are officially using CREI technical training for members of their staffs: All America Cables & Radio; Canadair Ltd.; Canadian Broadcasting Corporation; Columbia Broadcasting System; Douglas Aircraft Company; Florida Power & Light Company; Glenn L. Martin Company; Pan American Airways (Atlantic Division); Radio Corporation of America; Trans-Canada Air Lines and United Air Lines. These companies have been using CREI courses for longer than eight years in some cases and some individual companies have enrolled hundereds of their men.

OUR CONCLUSION: For a young man without professional electronic background and hence no means of acquiring adequate practical experience with major electronic equipment we unhesitatingly recommend our residence course. This also applies in the case of the professional who feels the need of diversified laboratory work with a concentrated study schedule in the minimum amount of time.

To the engineer or technician working daily with modern equipment who is thus able to apply his advanced studies to his practical work, it is our considered opinion, based on 28 years of experience, that the home study program if diligently pursued will do an equivalent good job plus definitely stamping the individual as a "man of determination". We can highly recommend either graduate to you.

YOU'VE READ THE FACTS—WANT TO KNOW MORE? For detailed information about any phase of CREI's Home Study or Residence program, and how it can help your technical manpower problems, or your technical training program, please write directly to me:

MR. E. H. RIETZKE, PRESIDENT

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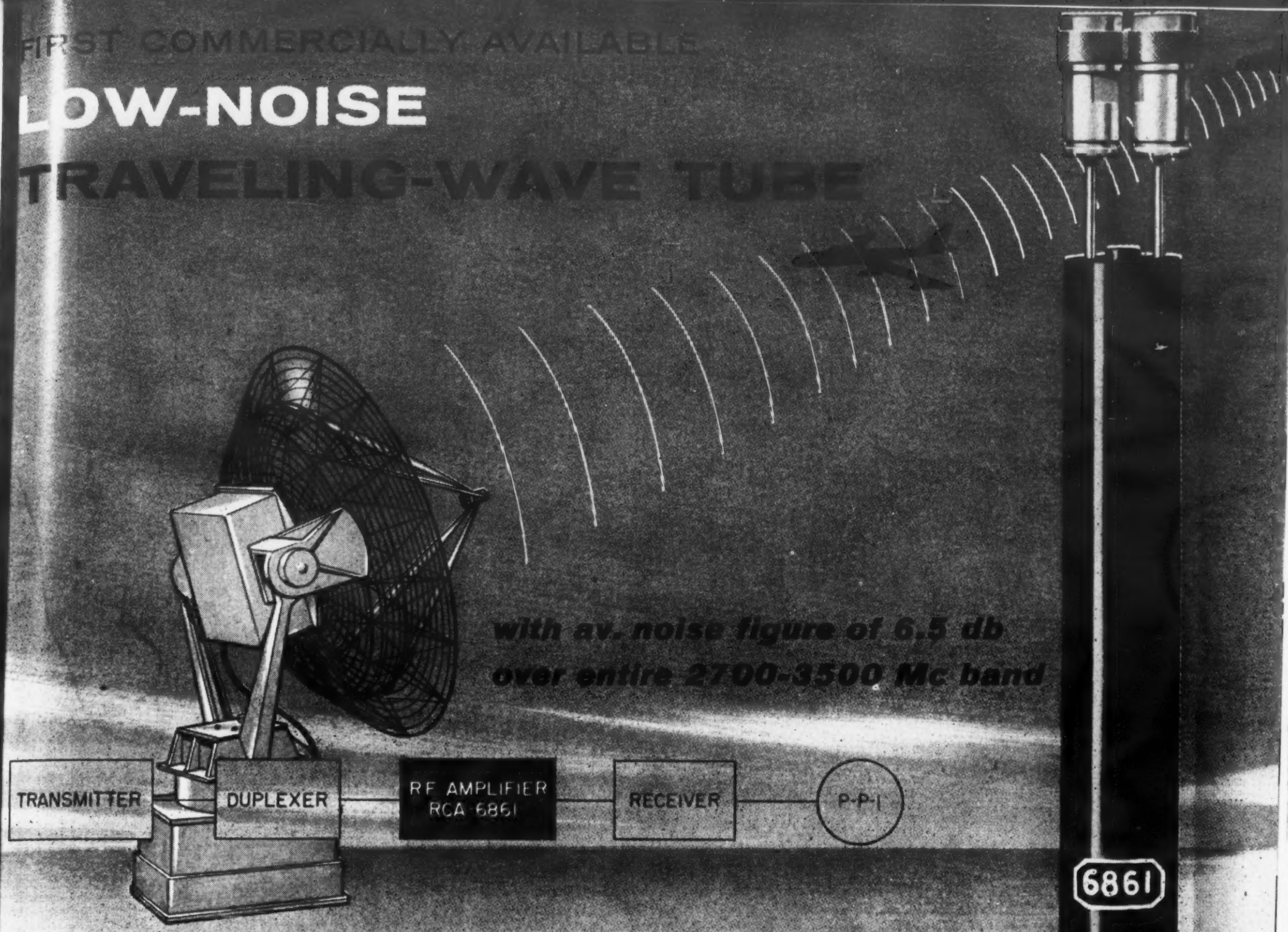


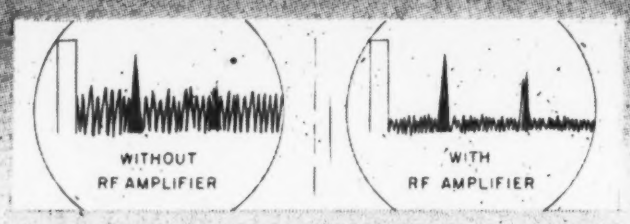
with av. noise figure of 6.5 db over entire 2700-3500 Mc band

- **increases S-band receiver sensitivity**
- **eliminates crystal "burnouts"**

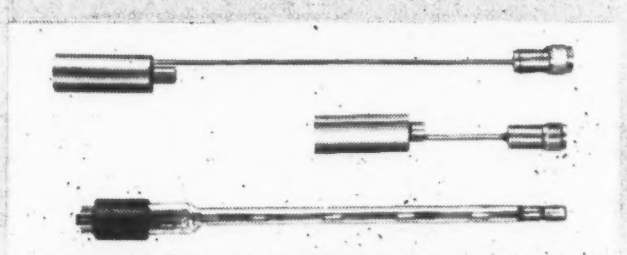
Now in production, RCA-6861 is a major advance in electron-tube design for microwave receivers. It enables—for the first time—the practical application of low-level rf-amplifier stages in radar, scatter-propagation, and other microwave receivers, and if-amplifier stages for millimeter-wave receivers.

The unusually low noise figure of 6.5 db is obtained by the use of an RCA-designed special type of electron gun which deamplifies noise generated in the electron beam.

Sales information on sample units or quantity deliveries is available. Contact your RCA Representative at the RCA District Office nearest you.



Patterns show signal-to-noise ratio at input to S-band receiver's crystal detector with and without a stage of rf amplification. Utilizing RCA-designed-and-developed type 6861 Traveling-Wave Tube, high signal-to-noise ratio and extended range are obtained. In addition, crystal "burnouts" caused by TR-tube leakage are eliminated by the isolation afforded by the rf stage.



Glass portion of RCA-6861 is enclosed with rf-input and rf-output transducers in tubular metal capsule. Transducers are factory-set for optimum tube performance; require no adjustment in the field. Capsule has terminals which fit the standard octal socket.

RCA-6861 DATA	
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Collector Voltage	400 volts
Collector Current	150 μa max.
Magnetic Field*	525 gausses
Noise Figure	6.5 db
Gain	25 db
Frequency Range	2700 to 3500 Mc

*field supplied by RCA solenoid Dev. No. 1-2006, or equivalent.

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For technical data on RCA-6861, write RCA, mercial Engineering, Section 8 60 o, Harrison,

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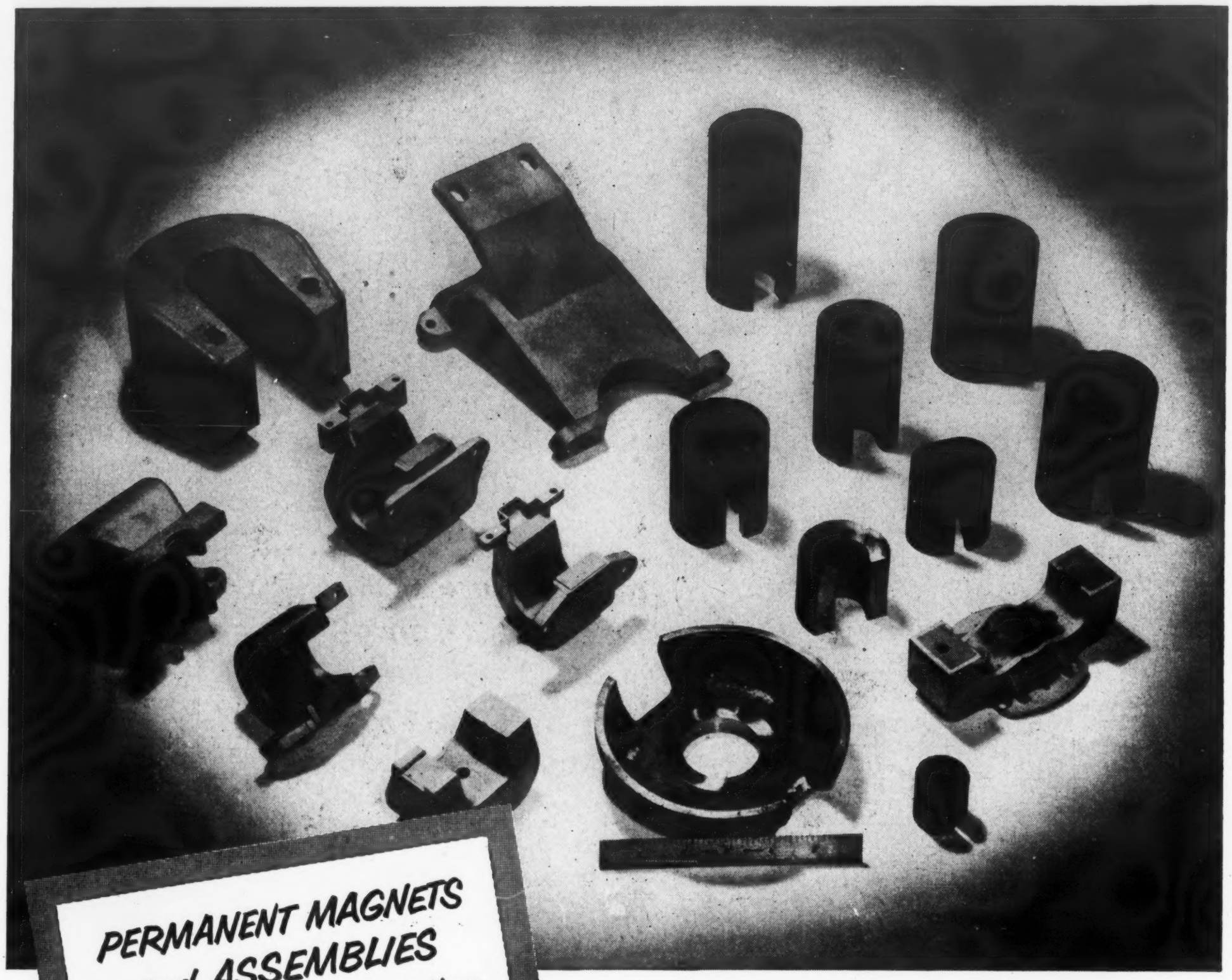
TUBE DIVISION HARRISON, N.J.



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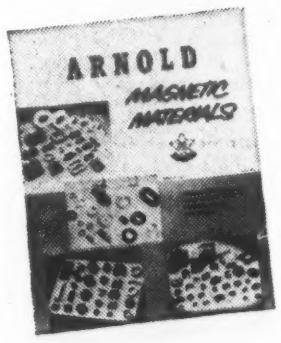

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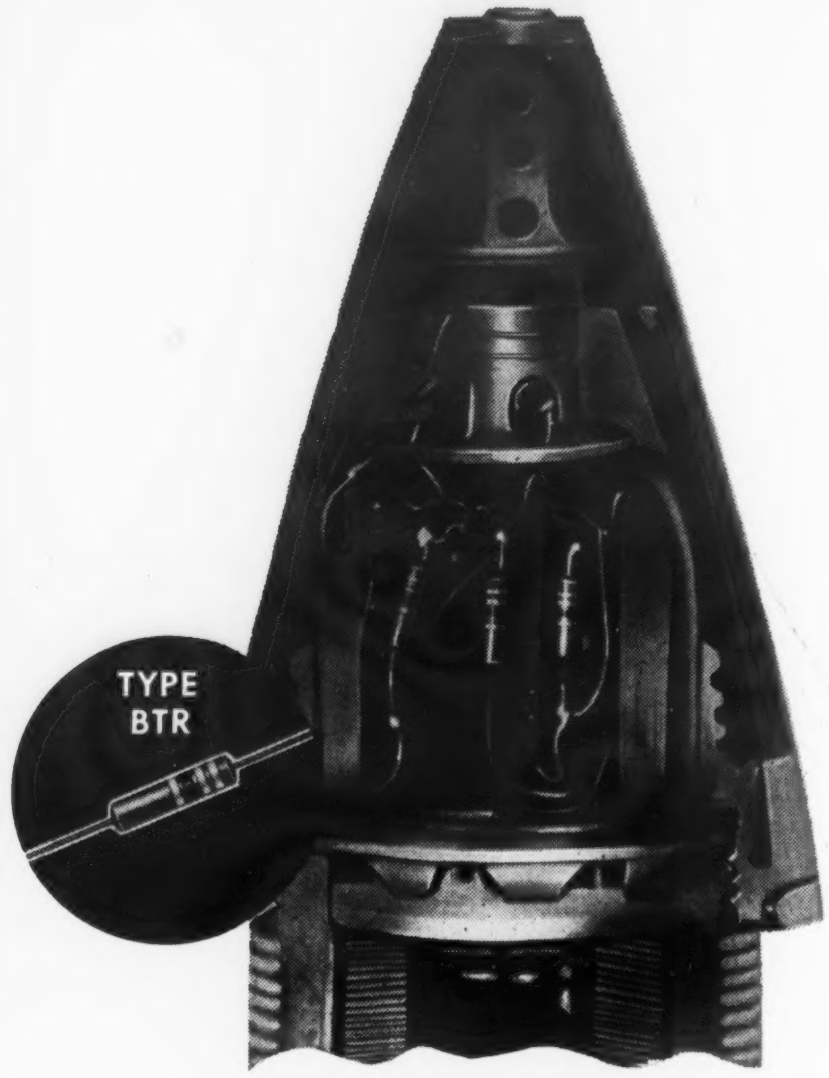

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In keeping with the theme of the Convention, the articles in the feature section of this special issue of SIGNAL all reflect some facet of our military-industry partnership. A few of the features, all by outstanding authors, point up existing problems, others offer solutions, and some articles describe the fruitful results of joint military-industry cooperative projects. We hope that all AFCEA members and SIGNAL readers will find each feature of lasting interest and value.

The Editors

One of the serious problems confronting every responsible citizen in this day of preparedness and defense is the manpower problem. Civilians and military personnel alike are concerned with the effect of the selective service and the recent Reserve Forces Act on their individual situations, and everyone is most concerned about the shortage of scientists and engineers. We present here four articles on the manpower problem, each with an important message.

The Selective Service System

by Major General Lewis B. Hershey, USA

Director, Selective Service System

The Selective Service System is an independent agency entirely separate from the Defense Department and reports directly to the President. General Hershey has been connected with the System since 1936. He was made its director in 1941, and promoted to his present Army rank of major general in 1942. As director, he has consistently emphasized the autonomy of the local boards as the most democratic selective service process.

WORLD EVENTS IN THIS AGE OF nuclear weapons, automation and push button warfare call for all forces concerned with national defense, both civilian and military, to maintain themselves in such a state of readiness as to be able to perform one or a combination of several missions not only well but in a manner superior to anything that might be expected of us by a potential enemy. This, of course, depends in large part upon a real understanding and trust shared mutually by both the civilian and military components.

Upon the back of the Selective Service System falls the "forty lashes save one" placed there by certain persons and elements who feel the System is composed of professional proselyters whose sole job is to interrupt civilian activities by placing men in military service. It is true that the Selective Service System is directly or indirectly responsible for the entrance into military service of most of the men carried on the morning reports today. But, in carrying out this responsibility, the Selective Service System has in action and

spirit kept as its Golden Rule those first two paragraphs of section 1 of the Universal Military Training and Service Act, as amended, which reads in part as follows:

> "The Congress hereby declares that an adequate armed strength must be achieved and maintained to insure the security of the Nation.
>
> "The Congress further declares that in a free society the obligations and privileges of serving in the armed forces and the reserve components thereof should be shared generally, in accordance with a system of selection which is fair and just, and which is consistent with the maintenance of an effective national economy."

In order to support essential civilian industry or "forces," certain rules and regulations were promulgated to allow for deferments of military service. *I repeat, to allow for "deferments of military service." I did not use the words "exempt from military service."*

Who Goes, and When

Occupational deferments should in no way be considered as granted in order that the registrant may perform civilian work in lieu of military service. Manpower procurement by the Selective Service System for the Armed Forces is direct in that we select individuals in their turn and deliver them to the requisitioning Service. If they are acceptable, they are inducted. Age and physical condition to a major degree, and occupation to a lesser degree, are the chief determinates as to whether or not a man shall be selected to go into the Armed Forces or have his training and service deferred so that he may remain for a certain time in a civilian activity.

Elaborating further upon age as a supply and availability factor, we find that our male manpower sources properly are divided into three groups: (1) the prime military manpower group; (2) the secondary military manpower group, and (3) the supporting civilian service group. These are defined and described more particularly as follows.

The prime military manpower group is that group within the ages 18 through 25. These naturally include the more physically fit, the less firmly established in the trades, skills or professions, and the man with fewest family obligations. From this group current military requirements should be met, including expansion and maintenance, until such time as full mobilization becomes necessary.

Older Age Groups

The second military manpower group is that group within the ages 26 through 35. This is the group to which we must turn for requirements over and above the numbers realized from the first group. This group must be drawn upon in the most careful selective way for, while it will include men still fit and able, they will be older men and men more experienced and mature. Henceforth, it will also include the greatest percentage of men with prior military training and service. However, this group should not be invaded to any substantial degree until full mobilization has become necessary.

Maj. Gen. Lewis B. Hershey, USA

The civilian service group is that group above 35 years of age. Of these very few should enter the Armed Forces except the professionals or semi-professionals and the very specially qualified. To this vast group, civilian users must look for the bulk of their retainable personnel in any emergency.

It is important to bear in mind that the needs of the military may withdraw from the civilian labor force. Employers must not be permitted to embrace the philosophy of retention with regard to either of the first two groups. He should never deny himself the services of young men and surely we must never deny young men the fullest possible opportunities for employment. But both the user and the young men should know of the possible realities and prepare to meet them. *If we all can grasp the idea that the militarily fit generally must be available to the Armed Forces, we can avoid a costly error of essential civilian activities placing their reliance for an expanded force upon men whom they must eventually release.*

Advisory Committees in Operation

In order to assist the Selective Service System in the determination of when a young scientist must fulfill his military obligation, a National Selective Service Scientific Group serving in an advisory capacity to the Director has been established, and State Advisory Committees on Scientific, Engineering and Specialized Personnel are in operation or in process of organization in every state in the Union, the Commonwealth of Puerto Rico, the Territories and in the Virgin Islands and the Canal Zone. Through membership in these committees nearly 300 eminent scientists, educators and other highly qualified individuals throughout the Nation have made their services available without compensation to the Selective Service System.

These committees should afford to the whole scientific engineering community the fullest opportunity to have the cases of individuals possessing critical skills or engaged in basic research or defense supporting endeavors most thoroughly considered. These same groups of patriotic scientists will also assist the Selective Service System in determining which of the young scientists who have not fulfilled their military obligation and are available for service should be permitted to enter upon the six-month reserve training program authorized for persons possessing critical skills and who are engaged in activities essential to the defense effort.

Selective Service is aware of the problem involving scientific, engineering, and specialized personnel, as it is aware of the problems of the millions of other individuals with whose lives it deals. Quietly, flexibly, and as promptly as circumstances warrant and permit, the System is taking real and positive action. This course often fails to satisfy some special interest servers whose eagerness too frequently overrides their judgment, but years of experience and contact with our people and their sons who most are involved have shown that it is the course which best serves the national interest.

Important New Provisions of the Reserve Forces Act

by Lieutenant Colonel Frederick P. Magers, USA

At Fort Gordon, Georgia, Pvt. John D. Huntley, a recruit who has chosen the six months plan provided by the new Reserve law, works with a vacuum tube detector at the Field Radio Repair Course where he learns a technical skill while also completing his basic Army training.

OUR HISTORY AS A NATION HAS BEEN punctuated dramatically by eight major wars—more than one for every generation—and by scores of smaller campaigns and skirmishes.

Until now, we have always relied on the vast expanses of ocean which separate us from our potential enemies, or on the fortunate circumstance of the enemy's being engaged in war with another nation or group of nations, to give us the time to train, equip and move our armies to combat. We have traditionally followed a policy of maintaining a small, well-equipped, well-trained Regular Army as a nucleus for rapid expansion, augmenting these forces with large numbers of citizen soldiers in time of emergency.

Now, atomic science and the development of efficient rocket missiles have made it possible for an aggressor to launch war at will upon our soil. We can no longer rely upon oceans or the interposition of our allies to protect us from attack.

These newly imposed conditions of time-space compression have necessitated a drastic re-appraisal of our national security concept. Laws designed to insure a large, well trained Reserve were enacted by Congress to provide a framework for such a force. However, participation on a voluntary rather than an obligatory basis, as envisaged by this legislation, resulted in serious inequities. Those to whom service to country became a self-imposed duty were unjustly penalized. Many volunteers were required to serve the Nation twice within the span of a few short years—with the attendant disruption of family life, business and education. Others, with prior service who had not volunteered for the Reserve were left untouched in their civilian pursuits, and more than a million and a half non-veterans were never called because they could not be made ready in time.

Congress soon realized that these inequities existed and that the only fair way to solve this problem required that *all* should serve. A new law, the Reserve Forces Act of 1955. containing this important provision was passed and signed by the President on August 9, 1955. Under this law, for the first time in our history, young men are legally obligated to bear arms in the national defense and to prepare themselves for war in time of peace.

What, then, does this mean to

The Author

Colonel Magers is chief of the Organizations Branch, Public Information Division of the Army Office of Information and Education. Although his basic branch is Armor, he has had General Staff assignments in information posts for the past several years.

those of us who are not liable for service under the provision of the Act? How will this legislation affect our daily living? Mr. A. Boyd Campbell, as President of the Chamber of Commerce of the United States, phrased concisely the implications of this Act when he said. . . "We now have a law which takes official note . . . that we have one labor force, one manpower pool and which attempts to make certain that the drain on the pool to meet military and civilian requirements is coordinated."

Special Plans Provided

Of particular interest are two provisions of the Act. The first of these, the Six Months Plan, is a special program applicable to young men between 17 to 18½ years of age. It is designed to permit these men to discharge their military obligations early in life with a minimum of disturbance. By enlisting voluntarily in this program for an eight year period, they spend six months on active duty training. During this time, they become skilled basic soldiers, ready to enter into the balance of the program. The training is designed to produce soldiers instilled with a sense of discipline and teamwork, with courage, aggressiveness, initiative, and similar attributes of leadership and whose physical conditions and habits are conducive to the maintenance of physical and mental fitness. Such men should be imbued with an understanding of the worldwide responsibilities of our nation and the necessity for their military service as an essential to the Nation's security.

The current list of critical skills and essential activities used by local draft and appeal boards is considering selection of persons eligible for participating in the critical skills aspect of the Reserve program is shown below:

Occupations

Chemist*
Clinical Psychologist
Die Setter
Engineer Draftsman, Design
Engineer Professional (All Branches)
Foreman (Critical Occupations Only)
Geologist
Geophysicist
Glass Blower (Laboratory Apparatus)
Jig-and-Template Maker
Mathematician*
Microbiologist*
(Includes Bacteriologist)
Nurse, Professional
Orthopedic Appliance and Limb Technician
Parisitologist (Plant or Animal)*
Pattern Maker
Pharmacologist*
Physicist*
Physiologist (Medical)*
Teacher, College and Vocational (Critical Occupations Only)
Teacher, High School (Mathematics and Physical and Biological Sciences only)
Tool and Die Designer
Tool and Die Maker.

***Limited to those having graduate degrees (master's or doctor's) or equivalent experience, education and training (generally considered not less than one year beyond bachelor degree level).**

Their remaining 7½ years of service are performed with a local Reserve unit. They are required to attend 48 two hour drill sessions and a 2 week summer encampment each year, until the obligation for the full 8 years of service has been satisfactorily met.

Benefits for Industry

There are several obvious advantages accruing to the young man who elects this program. It provides him the opportunity of being able to plan his own future. He is at an age when the acquiring of new skills and techniques, many of which will be useful to him in his civilian employment, is most easily accomplished. Morale-wise, he will spend his 7½ years of Reserve unit training in a local unit with contemporaries from his own community.

The American business community should also benefit materially from this program, since it was expressly designed to meet the interlocking needs for manpower by the Armed Forces and industry—at a cost our Nation's economy can afford for the long haul. The employer will acquire young men who will have been trained in skills and arts applicable to industrial requirements. He will be in a favorable position to determine in advance of any mobilization those employees he will be liable to lose first, which information should be of material advantage in long range personnel planning. The only major disruption in work scheduling will be for the two weeks summer camp since the weekly drill sessions are normally held in the evening.

RFA enlistee, Pfc. James E. Smith, examines and studies the parts of a T-38 Skysweeper under the supervision of Capt. R. F. Hazucha at the Ordnance School, Aberdeen Proving Ground, Maryland.

Critical Skills Program

The second major provision of the new legislation pertains to the young men with critical skills. As a Nation, we have made tremendous investments in standby plants and in the stockpiling of strategic materials. Stockpiling of critical skills must be regarded as an equally important facet of our military security program, since it will provide a workable solution for maintaining our military strength and, at the same time, insure that persons possessing critical skills are available to industry.

The Armed Forces Reserve Act of 1952 provides that the President may prescribe regulations authorizing enlistments into units of the Ready Reserve of those persons who possess critical skills and who are engaged in occupations in any critical defense-supporting industry or in a research activity affecting national defense. It further provides that a person may be so enlisted even though he has attained the age of 18½ years and has been ordered to report for induction.

Executive orders were signed by the President on January 6, 1956

(*Continued on page 62, col. 1*)

The Shortage of Scientists and Engineers and its IMPACT on our Air Technical Programs

by Lieutenant General Emmett O'Donnell, Jr., USAF

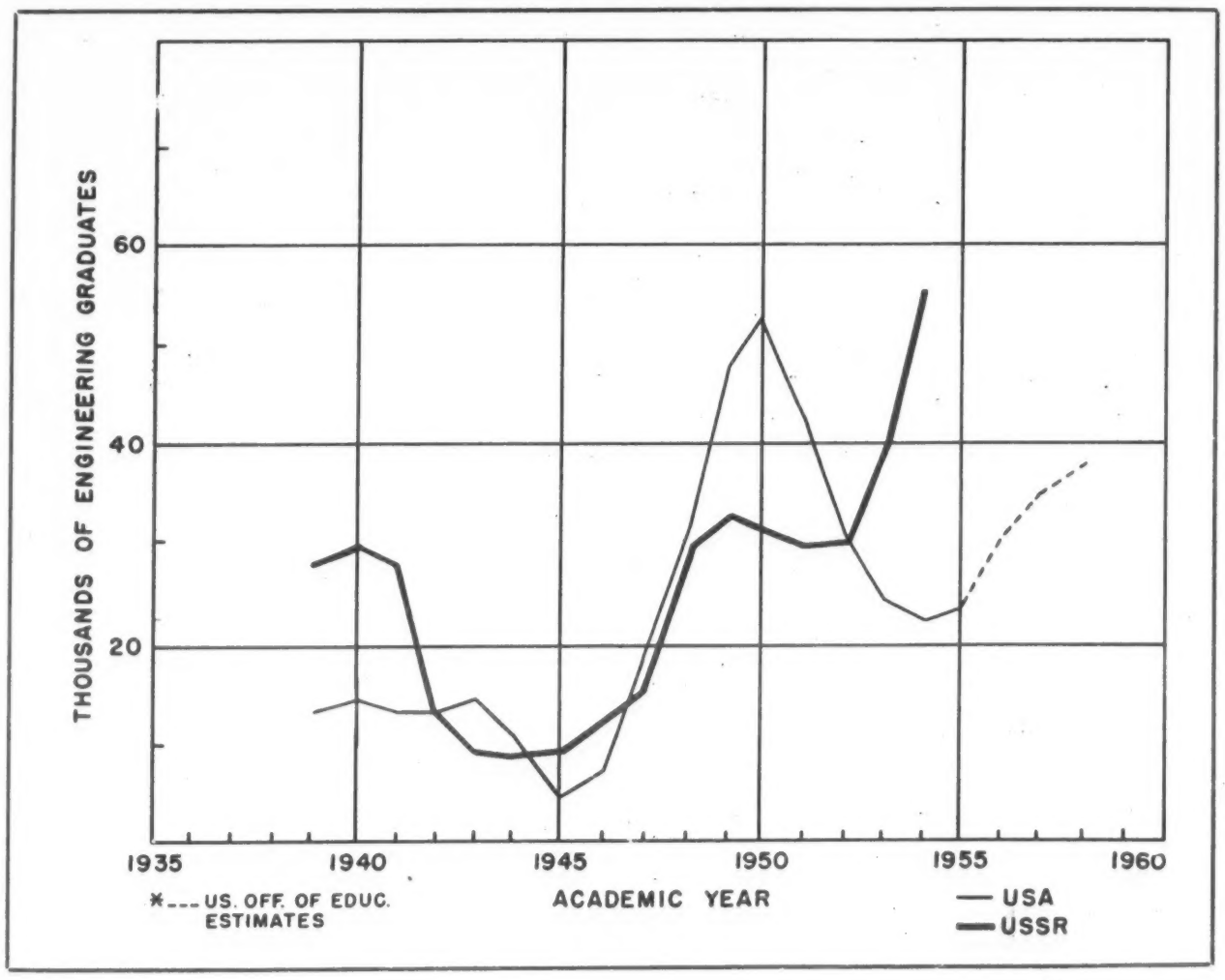
WE ARE LOSING A WAR. WE ARE losing it because we are losing the race to produce more and better engineers and scientists than the Communists are producing. The curves of Figure 1 give an idea of how far behind we are in the number of engineers now being graduated each year. At these rates, the Soviet Union's total number of graduate engineers will surpass our total within the next five years.

In terms of quality, most of the new Soviet engineers are graduates of five and even six years of intensive schooling, in contrast with our graduates of the normal four-year programs. It would be a tragic mistake to underestimate their abilities.

I am not being an alarmist. Hardly anyone will question the statement that our survival depends upon maintaining a qualitative technical superiority over the Communists. It seems quite undebatable that qualitative technical superiority depends entirely upon our having enough well-trained scientists and engineers to out-think and out-produce them in the continuing traditions of American ingenuity.

Neither am I being a defeatist. The Reds may be outracing us at the moment, true. We cannot ignore the facts. But, with our long-held head-start in technical know-how, we have a chance to recapture the ground we have lost and even to add to it. My purpose in this article is to discuss some of the effects of the shortage of technical manpower upon the civilian economy and the Air Force. I shall also mention a number of partial solutions, in progress and proposed, for the problems which the shortage has created.

Figure 1. Graduation Rates in Engineering—USA and USSR. The data on the engineering degrees granted in Russia are based on a recent National Science Foundation study, "Soviet Professional Manpower" by Nicholas deWitt. U. S. figures are based on data supplied by the U. S. Office of Education.



"Lead Time" for Scientists

Perhaps the most serious problem, and one which has no immediate solution, is the problem of the "lead time" required for the education of technical men. We learned the importance of "lead time" in World War II: it took us five years to develop and fly the B-29; the more complex modern aircraft require an average of eight and sometimes as many as fifteen years to get from the drawing board into operational squadrons.

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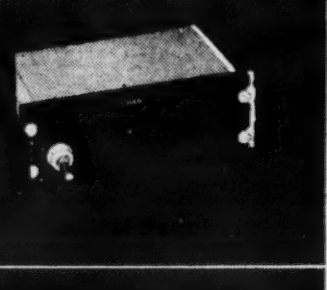

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competent scientist or engineer is an almost irreducible figure of the same order. Despite the apparent rising trend in the number of American engineering graduates each year, (Figure 1, dotted line) the difference between the number required and the number available is expected to exceed 60,000 by 1960. According to present trends, the shortage of physical scientists in the same year may well exceed 50,000.

Our expanding economy now requires 35,000 new engineers a year above the 20,000 required for annual replacements. The demands for qualified men must be weighed in a delicate balance between the civilian requirements and the needs of the defense effort. The distribution of the available supply must be made with the full cooperation and understanding of the leaders in both fields. We must take steps to insure that we never again are overrun in this "War of the Classroom." I will discuss those steps later.

Air Force Build-Up

I should like to delve into this manpower problem a little more deeply to examine its effect upon our air power and to explain some of the means by which we are attempting to solve it. Within the next year, the United States Air Force must complete its scheduled build-up to 137 flying wings without, incidentally, adding appreciably to its manpower. Even then the Soviet aircraft will outnumber ours by thousands of jets, so we must have qualitative superiority. This means, in turn, that our aircraft and weapons will be ever more complex and that our demand for technical specialists for maintenance in the combat wings and for continued research and development in the laboratories will increase critically.

Requirements for professional engineers and scientists are found in every command in the Air Force and range from maintenance specialists to nuclear physicists. Most of such requirements, however, are in the groupings listed in Table I, all of which call for officers with an education equivalent at least to the bachelor's degree. This table shows how far the percentage of college graduates in operational activities of the Air Force falls below the 100% figure.

Career Field	*Assigned Officers*	*Number with Degrees (%)*
Research & Development	**4,167 (1747*)**	**100%**
Communications & Electronics	**6,051**	**40%**
Armament Engineering	**2,379**	**47%**
Maintenance Engineering	**5,312**	**21%**
Total	**17,909**	***Number of lieutenants**

Table I. Some USAF Requirements for Officer Scientists and Engineers (as of December 1955).

In the past, the research and development career field has received first priority for the assignment of officers with degrees in science and engineering. All of the technical positions in Air Research and Development Command are now manned with officers holding college degrees. We can now assign many of the incoming AFROTC engineers and science majors to the communications networks and flying components of the Air Force.

The figures in the table also show the large number of lieutenants assigned to research and development. This is the result of our critical shortage of captains, majors, and lieutenant colonels with the required technical background. The large number of lieutenants who leave active duty after a few years, leaves us with a continuing shortage of officers with the competence that only broad experience can provide.

R & D Requirements

What we are doing to meet our requirements in the field of research and development is of interest. Our problems can be listed as finding, assigning, training, and retaining our research and development officers. (I do not mean to neglect similar problems in the civilian component of our technological requirements, but within the scope of this brief article I cannot treat them adequately.)

To find our research and development specialists, we conduct continuing surveys of the qualifications of all Air Force officers. Trained analysts interview every officer annually and award appropriate research and development specialty designations to all those who qualify by experience or training.

Principally on the basis of qualifications, these officers are then assigned by Headquarters USAF to the career fields in research and development where they are needed and can do their best work. Every major command submits monthly manpower requisitions, and the available specialists are apportioned according to highly selective criteria.

Air University Status

The professional education of our officers falls within the jurisdiction of the Air University Command. One of its most vital units is the Institute of Technology, located at Wright-Patterson Air Force Base, near Dayton, Ohio. The mission of the Institute is "to provide education and training to meet the requirements of the Air Force in scientific, technological, managerial, foreign language, medical, and other areas. . ."

The Institute accomplishes this mission essentially in two ways: through its Civilian Institutions Division and through its Resident College. The programs of technical education now pursued by almost 500 Air Force officers at about 50 civilian colleges and universities throughout the country are scheduled and monitored by the Civilian Institutions Division. These programs range from the advanced undergraduate through the post-doctoral level. In the ten years of its existence, the Institute has seen more than 3,000 officers

The Author

General O'Donnell was graduated from the U. S. Military Academy in 1928 as an Infantry officer. Immediately, however, he began his aviation career with training at Brooks Field and Kelly Field. He held various assignments in the Air Corps in the 30's, and, in addition, was football coach at West Point from 1934-38. During World War II, General O'Donnell distinguished himself in various command positions, both in the States and in the Pacific Theater. Since then, he has held command assignments with the Air Materiel Command, the Strategic Air Command and as Director of Air Force Information. He is presently Deputy Chief of Staff for Personnel at Air Force Headquarters.

graduate from civilian institutions as engineers and scientists.

At its Resident College, the Institute offers undergraduate or postgraduate education, leading to degrees, in such specialized technical fields as nuclear engineering, armament systems, servo-mechanisms and computers, air ordnance, electronics, aerodynamics, aircraft structures, and propulsion. In ten years, the Resident College has graduated approximately 1,000 highly trained engineers.

Students for both these programs are selected from volunteers according to the critical compromise between the manpower demands of the operational components of the Air Force and the requirements for officers with technical training. Neither phase of our air power can be neglected, and this fact is recognized also in the duty assignments of the student officers after graduation.

Another responsibility of the Air University is administration of the Air Force ROTC program, the largest educational undertaking of the Air Force. About 98,000 students are enrolled this year in some 206 colleges and universities. Of the 7,000 seniors graduating this year, 5,500 will go directly into flight training. However, 30% of these rated officers will be graduate engineers and will come under the scrutiny of the classification analysts after they have acquired flying proficiency.

Because of the rigid manpower ceilings now in effect, the number of non-rated seniors available directly for scientific and technical assignments is limited to 960.

Problem of Attrition

The final Air Force problem I will discuss here is that of retaining these technical men after we find, assign, and train them. (I mentioned earlier the high rate of attrition among technically trained junior officers.) At present only 9% of our non-flying lieutenants ask to remain in service after completion of their ROTC-obligated tour of duty. This problem is getting the serious attention it deserves and we hope to solve it soon. We find that a much higher percentage of the rated lieutenants ask to remain on active duty.

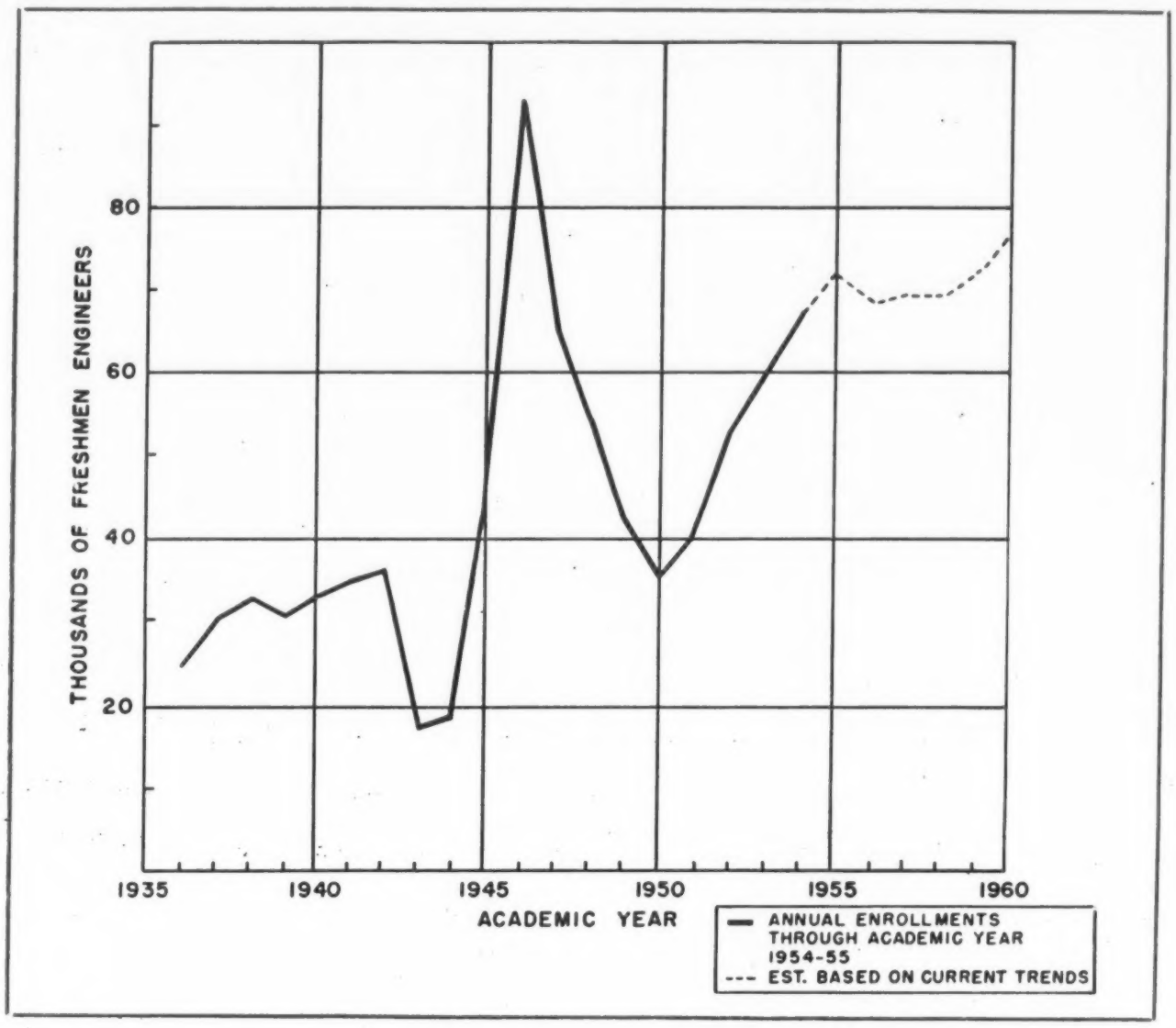

Figure 2. Freshman Students in Engineering, USA. Figures for the past and present enrollments are based on reports of the U. S. Office of Education and the American Society for Engineering Education. Estimates of future enrollments are by the U. S. Office of Education.

To turn from these special Air Force problems, let us examine some means by which we as a Nation can combat the alarming shortage of engineers and scientists. I cited earlier the concept of lead time as the limiting factor in the training of technical men. This means that there is relatively little we can do to increase the number of these men immediately—or even within several years. Time is an absolute requirement; however, with thoughtful planning and vigorous action we can insure our future production of professional men at a high level. By "we" here, I mean everyone: the man in the school, the man in industry, and the man in Government.

Figure 2 shows the Office of Education figures on the number of college freshmen currently enrolling in engineering; the dotted portion of the curve is its estimate of future enrollment—subject, it says, to upward revision. *I submit that it is our responsibility to see that the figures are revised upward in actuality.* I can think of several ways by which we can see to it that these figures are raised. We know that the upper 20% of the high school graduating classes contain the most likely prospects for technical education, and yet half of these superior students do not go on to college. This means that every year 120,000 to 130,000 potential professional men are lost. We can do at least three things about this situation: (1) motivate the students properly; (2) counsel them properly; and (3) help them financially.

To motivate the students properly, we must educate them in the broadest sense. That is, not only must we give them a sound foundation (and thus an interest) in mathematics and the physical sciences; we must also help dispel their erroneous impressions of the scientist as a long-haired recluse in a laboratory and the engineer as a hairy-eared ruffian in field boots. Recent surveys of high school students indicate that this is what they really think, but there is little doubt that concerted campaigns by industry, Government and teachers can change their minds.

Benefits for Teachers

Another aspect of motivation and education I can think of requires that we, as well as the student, change some of our older ideas. *I refer to the concept of educating and employing women as scientists and engineers.* The Soviet Union has demonstrated the practicability of this, and although we certainly should not follow them to extremes, we can make considerable improvement in the use of our human resources.

To counsel the students properly is rightfully within the province of the schools. However, it seems to me that we in industry and Government can supplement the psychological tests and the patient wisdom of the school counsellor by such devices as *offering post-high school summer employment to students in the fields*

(*Continued on page* 71, *col.* 1)

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an improved "Farm System" to develop the future team of scientists and engineers

by James M. Mitchell
Associate Director
National Science Foundation

WE NEED NOT SEARCH FAR TO FIND reasons for shortages in certain disciplines of science and areas of engineering. Into the most recent decade, we have crowded a whole century of progress in science and technology. Borne on the momentum of need to meet the exigencies of a World War and the Korean conflict, our headlong advances in science have outraced our capacity to produce trained personnel.

A simple call-over of the areas in which science has taken seven-league strides within the decade indicates immediately the impelling need for manpower — *industrial applications of nuclear energy, solid state physics, development of the transistor, jet propulsion, computers, solar energy, biological and chemical derivatives in medicine and pharmacology, automation, geochemistry, geophysics,* and others too numerous to mention here. We count in handfuls the scientists and engineers who can work with confidence in the field of nuclear physics. Similarly, the burgeoning aeronautics and electronics industries could readily absorb thousands more engineers were they available. We are short, as well, of qualified scientists and engineers, particularly for research and development programs, in chemistry, physics, metallurgy and mathematics.

Unprecedented technological advancement crowded into an almost inconceivably short time-period is the essential reason for our shortage of well trained scientists and engineers. We cannot afford to let this supply-demand imbalance exist for long if we are to maintain a thriving technological economy—and, importantly, if we are to secure our defenses. Although we will have our hands full to meet domestic demands for scientific manpower, we will have our arms full to satisfy this demand *and* the demand forced upon us by the threat inherent in the portentous progress of Soviet technology.

I propose not to dwell on this challenge here, but for sober reading I refer you to Nicholas deWitt's book, *Soviet Professional Manpower,* recently published by the National Science Foundation in cooperation with the National Academy of Sciences—National Research Council. Suffice it to say that our cold-war antagonists are in dead earnest as evidenced by the fact that they graduated 632,000 professionals in the engineering field between 1928 and 1954 while during roughly the same period we graduated 480,000. We have our arms full indeed.

Dr. Killian's Report

As we search together for solutions to the problem of shortages of scientists and engineers, I wish to call particular attention to the current Report to the Corporation of Dr. James R. Killian, Jr., President of the Massachusetts Institute of Technology. Near the outset of his observations, Dr. Killian writes:

> "While the United States has experienced shortages of professional talent in the past, notably of physicians, we have not in many years experienced so great or persistent an imbalance between supply and demand as we now have in science and engineering. The sustained scarcity of professional manpower in these fields, having been widely proclaimed, is now generally recognized, and its handicap to the nation is becoming understood.
>
> "Not so well recognized and understood or stressed is the qualitative nature of the shortage. We have a shortage of young engineers competent to handle new, advanced technologies. We have a shortage of research scientists and engineers (the demand for whom has been doubling every decade). We have an acute shortage of scientists whose creative and conceptualizing powers are exceptional. We have, in summary, a shortage more of basically educated, versatile young talent than of mere numbers of scientists and engineers. There is indeed a shortage of numbers in many but not all fields of science and engineering; we could better cope with such a shortage did we not also have an even more severe shortage of quality, depth, adaptability and up-to-dateness."

At this early juncture in the baseball season, I need hardly stress the importance of quality and depth. Whether you sat in the bleachers or the grandstand, many of you recall the misery of pitchers who faced the

mighty Yankees of yesterday—from Phil Rizzuto through Keller, Ruth, Gehrig, Henrich, DiMaggio, to say nothing of Dickey, Lazzeri, Crosetti, Gordon and Red Rolfe. And with men like Shawkey, Ruffing, Hoyt and Gomez eagerly waiting their turn on the mound, great wonder that the Yanks lost any games. We who live and work in the Nation's Capital hope that someone has told the managers of the Washington Senators this year about quality and depth!

School Enrollment Figures

Quality and depth in science manpower are, in my judgment, the urgent needs of today. To keep the baseball analogy for a moment, we must establish a Yankee farm system to field well trained science teams of tomorrow. And when we examine the science "farm system"—the training of the youth of America for science careers—we begin to find reasons why we have a science-manpower problem. Using estimates of the United States Office of Education and of Dael Wolfle in his book *America's Resources of Specialized Talent*, let us first try to see what proportion of American youth finds it way into fields of science and engineering.

Secondary school enrollments were 7.4 million in 1955, an increase from 2.5 million in 1920. Despite this tidal wave of secondary school matriculation, the percentage of high school students enrolled in most science courses has steadily decreased. In rounded figures, 9 percent of all high school students were enrolled in physics courses in 1922, 40 percent in algebra, 23 percent in geometry, and 7 percent in chemistry. For these same courses in 1954, only 4.6 percent were enrolled in physics, 25 percent in algebra, 11 percent in geometry, and the percentage enrolled in chemistry has remainly roughly constant—a little more than 7 percent. It is significant to note, as well, that while most high schools offer either chemistry or physics, some offer only one, and some offer neither.

Even more disheartening is the fact that less than half of the top 20 percent of our most capable high school youngsters continue their education beyond high school. This problem was pointed up sharply in the National Science Foundation's recent publication, *Scientific Personnel Resources* which drew upon careful studies by the Commission on Human Resources and Advanced Training as follows:

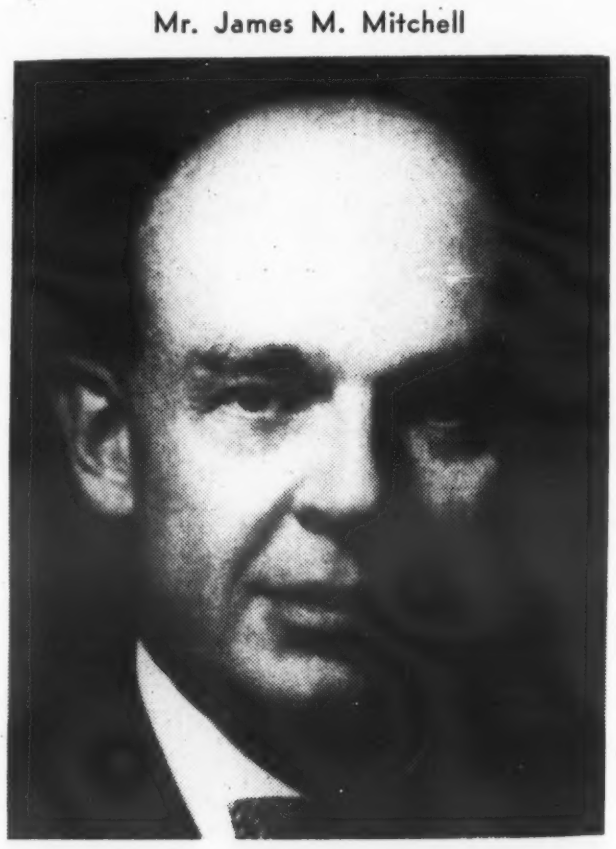
"The average score of an age group is 100 on the Army General Classification Test (AGCT). This is roughly the same as an intelligence quotient of 100 as measured by similar tests. According to studies by the Commission on Human Resources and Advanced Training, AGCT scores of college graduates will average about 120.

"According to the data on educational achievement as presented by the Commission, about 19 percent of the age group will score 118 or above on the AGCT. Of this group 98 percent will enter high school; 93 percent will graduate from high school; 44 percent will enter college; and 35 percent will graduate from college. In other words, about 65 percent of these capable students do not complete college. Only about 2 percent of them fail to enter high school, and about 5 percent of those who enter high school fail to graduate. The greatest loss, therefore, occurs between high school and college. Nearly half of the students with AGCT scores of 118 or above, and who graduate from high school, fail to enter college."

Despite the drop-out of capable students between high school and college, ever increasing numbers of our youth are enrolling in college but decreasing proportions are majoring in science courses. Chemistry accounted for 4.1 percent of all bachelor's and first professional degrees awarded in the 1921-25 period; physical science, 3.7 percent; engineering, 10.3 percent. For the 1951-53 period, chemistry accounted for only 2.1 percent; physical science, 2.3 percent, and engineering, 9.6 percent.

Possibly most disheartening is our critical shortage of well trained, secondary school science teachers. However well motivated our efforts to encourage youth toward science careers, we do them an injustice if we fail to provide adequate numbers of good teachers. No such provision is being made today. Nor would I have anyone construe such observation as a criticism of the present corps of secondary school science teachers. Far from it—many of them are superior teachers and we are richly indebted to them. But the number of these good teachers is far from adequate to train the onrushing waves of students.

Mr. James M. Mitchell



The number of graduates who completed standard certification requirements to teach high school science has decreased from a high of 9,100 in 1950 to a low of 4,000 in 1954. Similarly, in mathematics, qualified teacher graduates dropped from 1.1 percent of all who qualified for high-school teaching in 1950 to 0.8 percent in 1954. Here resides the real challenge for us to be alert to needs in our own communities.

Industry Program for Education

Within United States' tradition, education is primarily a matter of local concern. *It was in the interests of provoking local action throughout the Nation that Admiral Lewis Strauss, of the Atomic Energy Commission, and General David Sarnoff, of the Radio Corporation of America, exhorted business and industry to release some of their scientists and engineers to complement and supplement the Nation's hard-pressed corps of science teachers.*

Infusion into our school systems of men and women with the training of members of the Armed Forces Communications and Electronics Association could serve a helpful purpose by supplementing the knowledge of teachers with present-day technological concepts. As a matter of fact, industry is very conscious of its responsibility to help solve the problem of the science-teacher shortage and is doing much to provide adequate training programs.

The DuPont Company provides extensive programs of education in the sciences, including a mathematics fellowship program, grants to improve chemistry teaching and a master's degree training program for high-school science and mathematics teachers. General Electric sponsors summer fellowships for high-school science teachers; Westinghouse sponsors summer science teaching fellowships; Union Carbide & Carbon se-

lects high-school science teachers for summer participation in activities of its Bakelite plants; the Shell Company this summer will underwrite seminars for high-school science and mathematics teachers at Stanford and Cornell, and the Crown-Zellerbach Company each year supports summer institutes for high-school science teachers. The list is long and includes as well programs sponsored by many privately endowed foundations, professional societies and organizations, and universities and colleges.

Federal Government Participation

The Federal Government, as well, supports on a nation-wide basis many programs designed to enrich the environment from which will be drawn adequate numbers of well trained scientists and engineers to sustain the future defenses, economy and health of the Nation. Because I am most familiar with them, I will cite examples from the work of the National Science Foundation. The Foundation this year dedicated one million dollars to support 21 summer institutes and two academic-year institutes for secondary school and college teachers of science.

These institutes, widely distributed geographically and covering a broad range of science subject matter, will be the centers of intensive learning for groups of 50 teachers at each institute, renewing academic contact with their fields of knowledge for periods of from four to eight weeks for summer institutes and 32 weeks for the two academic-year institutes. With these institutes, the Foundation will have supported a total number of 38 within the past four years. Teachers have returned to their classrooms enthusiatic in their praise, and this year the House of Representatives Committee on Appropriations described as "potentially one of the most valuable programs the Foundation has . . . the one for supplementary education of high school mathematics and science teachers." The Foundation is planning a substantial expansion of the summer institutes program in 1957.

The two experimental academic-year institutes for high school science teachers will be carried out cooperatively with the University of Wisconsin and the Oklahoma A & M College where courses will be offered in science and mathematics designed especially for in-service teachers.

Other training-ground programs supported by the Foundation include:

1. Research grants and fellowships. The Foundation in fiscal year 1955 awarded 588 grants totalling $7.8 million in support of basic research in the natural sciences. One or two research assistants work with each principal investigator, thus broadening the base of the number of persons trained for future research and teaching. In the same period, the Foundation supported 785 fellowships in the pre-, intermediate, and post-doctoral areas, thus further extending the number of persons trained for careers in science and teaching.

2. A visiting lecturer program. The Mathematical Association of America selected five eminent mathematicians, available most of the academic year 1954-55, for week-long visits to small colleges. This program is being resumed under a new grant in 1956. In addition, the Foundation will support the American Chemical Society and the American Institute of Biological Sciences in the conduct of similar programs.

3. A traveling libraries program for high schools. The Foundation is supporting this project of the American Association for the Advancement of Science, involving the circulation of carefully selected science books to small high schools where students normally do not have access to typical high school science courses.

4. In the academic year 1956-57, the Oak Ridge Institute for Nuclear Studies will conduct a pilot program in which visiting teachers will carry demonstrations of the physical sciences to selected high schools. The program is supported jointly by the Atomic Energy Commission and the Foundation. Eight science teachers will be given a special course of training at Oak Ridge. Each teacher will be provided a station wagon equipped with instruments and apparatus that will enable him to demonstrate important principles of physical science not commonly taught in high schools. Beginning next September, the eight trained demonstrators will pay one-week visits to more than 200 high schools during the course of the academic year. During their tour the demonstrators will instruct teachers in the construction of simple apparatus for use in science teaching.

5. The Foundation supports and encourages efforts to improve science curricula at both the secondary and college levels in the form of conferences designed to bring college teachers and eminent research scientists together for the purpose of considering recent scientific developments and their proper place in the curriculum. Another type of conference designed to improve science curricula brings together for given fields of science in particular geographic regions a number of eminent scientists, college teachers and administrators, high school teachers and administrators, and representatives of state education departments for the purpose of coordinating the region's total science teaching program.

6. National Committee for the Development of Scientists and Engineers. On April 3, 1956, President Eisenhower established this Committee, and named as its chairman, Dr. Howard L. Bevis, President of Ohio State University. In establishing the Committee, the President said: "The National Science Foundation will provide staff services for the Committee and provide leadership to other departments and agencies in carrying forward activities which will contribute to a solution of the problem." The President directed the Committee to report progress to him with reference to:

(1) helping the Federal Government with plans to develop more highly qualified scientists and engineers,
(2) enlisting the cooperation of interested individuals, groups and organizations outside Government,
(3) making available information on ways to train more qualified scientists and engineers, and
(4) publicizing the problem and possible solutions.

Need for Action Now

To support, to stimulate, to encourage, to forewarn—these measures the Federal Government can and should take to undergird the Nation's principal source of science manpower—its splendid educational system. To cause action to be taken — that is the province of citizens in local communities throughout the United States and of alert professional organizations like the Armed Forces Communications and Electronics Association.

Players for the United States science teams of tomorrow are abundantly available—it is up to each of us concerned with the quality of the players to provide the best coaching possible for this science farm system if we are to develop worthy competitors to meet tough schedules at home and rough competition abroad.

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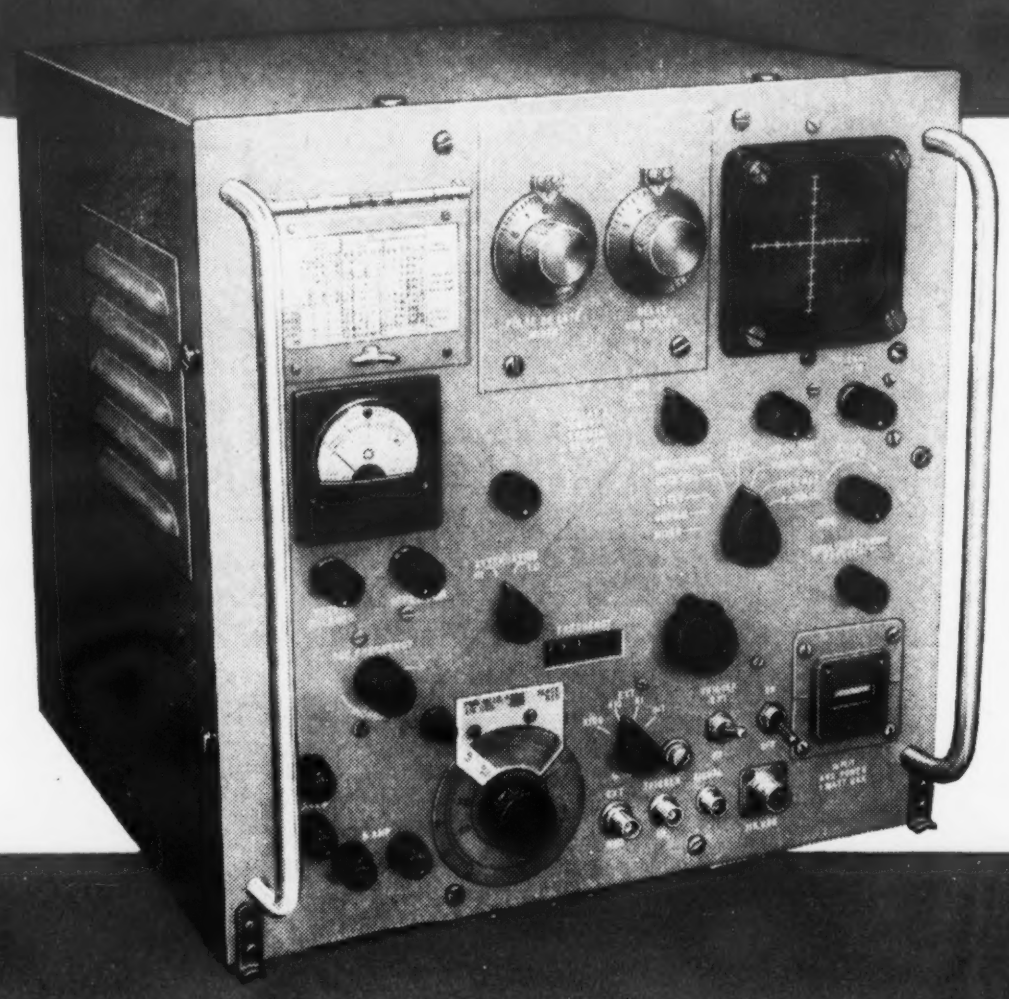

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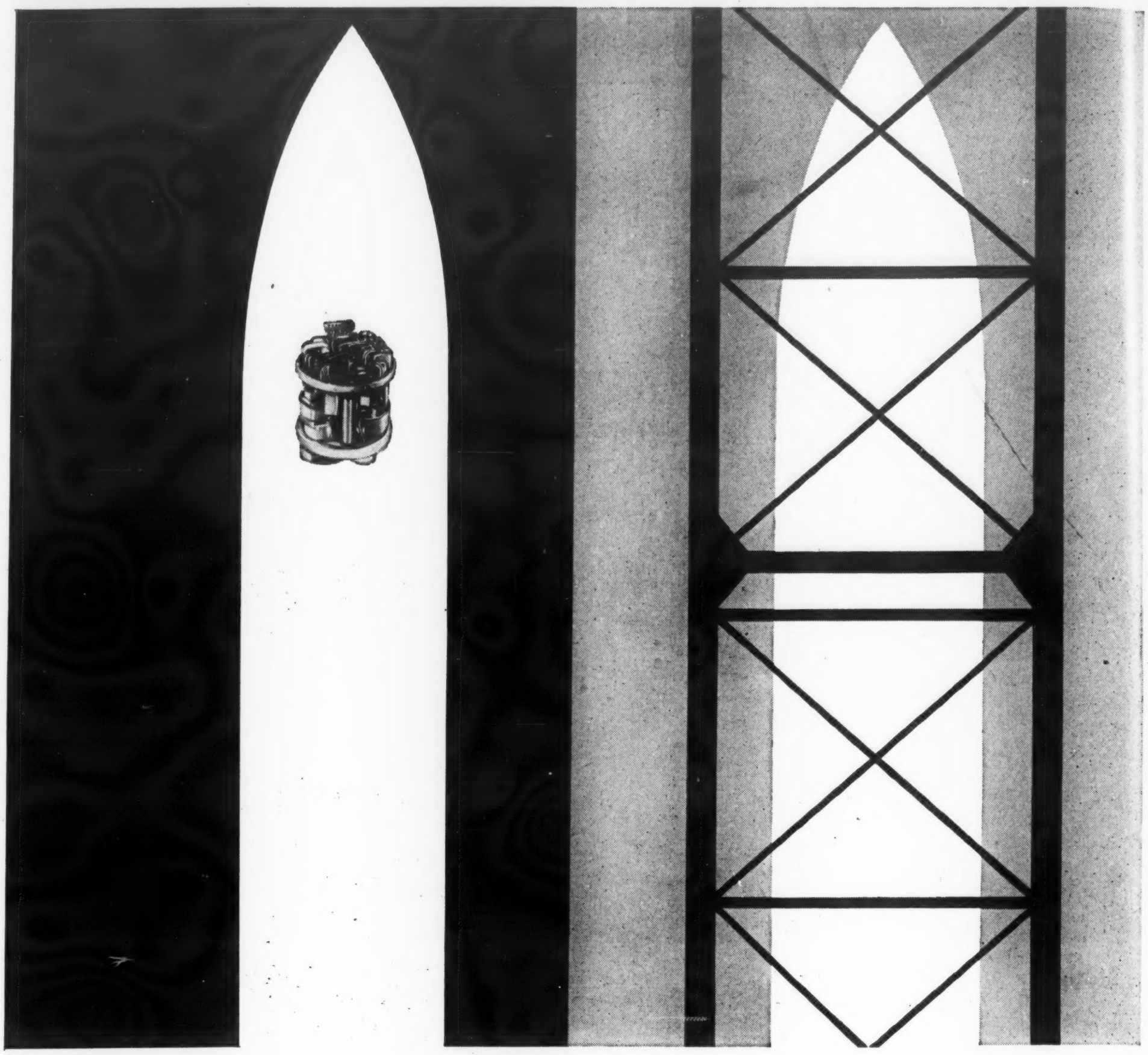

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R & D in the Department of Defense

by Charles DeVore
Associate Editor, SIGNAL

"The Federal Government through 29 different agencies conducts programs of research and development. On the basis of the budget proposals for the fiscal year 1956, the total expenditures of the Government for that year will be about $2,400,000,000, of which about $2,050,000,000 is in the Department of Defense and $350,000,000 in the civilian agencies. A total of at least 124,000 persons in the military and civilian departments participate in these programs. If we include the research and development carried on by our industries and nonprofit institutions, the aggregate sum probably exceeds $4,500,000,000 annually.

"This organization of research and development in the Government is the largest integrated scientific and technical endeavor that any nation has ever attempted. **The programs in the departments reach through the realm of abstract science, the evolution of scientific discovery into inventions and improvements. In the military departments, the developments of inventions and improvements in weapons extends into the test of these improvements; the development of production programs; the placement and coordination of production, and, finally, production must be accompanied by continuous further research and constant evaluation of results.**

"The organization of all Government research and development has been a slow growth and a constant realignment to meet every discovery in basic science and the inventions which flow from these discoveries."

from "A Report to the Congress by the Commission on Organization of the Executive Branch of the Government" (Hoover Commission) on "Research and Development in the Government," dated May 1955.

WHAT HAS BEEN THE GROWTH OF RESEARCH AND development within the Department of Defense? It goes back a lot further than the establishment of the Department of Defense in 1949. Perhaps the beginning was the National Academy of Sciences. It was set up by Congress early in 1863, with the purpose of focusing scientific talent on the Civil War. The Academy membership was drawn from American scientists and engineers. Originally, the membership was limited to 50, but this limitation was later removed, and by 1940 the membership had grown to nearly 300.

From World War I to the Present

By World War I, the fields of science and their relation to national defense had grown to the point that President Wilson asked the Academy to expand its services; the National Research Council was the result. It was established as a permanent agency in 1918 by an Executive Order. The Council was organized by divisions and its membership included representatives of the principal national societies or organizations, representatives of Government, and members at large. In the spring of 1940, the Council numbered more than 1,100 members and was doing research for the Army, Navy, and other departments of the Government. It is, of course, in operation today.

On the more military side of research and development, a Council of National Defense had been created in 1916 "for the coordination of industries and resources for the national security and welfare." It included the Secretaries of War, Navy, Interior, Agriculture, Commerce, and Labor. With the approval of President Franklin D. Roosevelt, this Council issued an order in June 1940, creating the National Defense Research Committee. Then, one year and one day later, an Executive Order established the Office of Scientific Research and Development, which included the NDRC. OSRD was placed within the Office of Emergency Management, a part, in turn, of the Executive Office of the President. The Executive Order stated that OSRD was being established "for the purpose of providing adequate provision for research on scientific and medical problems relating to the national defense." The accomplishments of the OSRD, under the directorship of Dr. Vannevar Bush, are detailed in a series of volumes with the common title of *Science in World War II.* A summary of the work of the organization is contained in the book *Scientists Against Time,* by James Phinney Baxter, 3rd.

OSRD was intended to be only a World War II agency. At the end of 1947, it was terminated and "all personnel, property, contracts records, and funds" transferred to the new National Military Establishment, which, in turn, was officially designated as the Department of Defense by the National Security Act amendments of 1949.

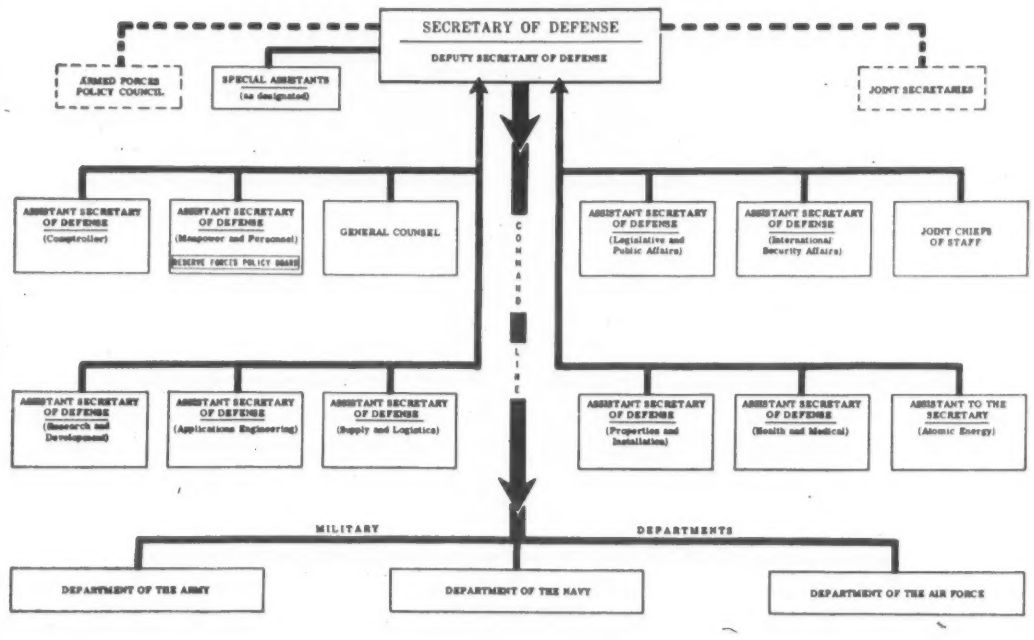
In June, 1946, a Joint Research and Development Board was organized directly under the Secretaries of War and the Navy, with the function of coordinating the research programs of those two departments. The National Security Act of 1947 raised the JRDB from a departmental level to a national defense level and made it a part of the newly created office of the Secretary of Defense. It also got its name changed to Research and Development Board. The RDB, however, had neither the authority nor the responsibility to direct or control the internal administration of the research and development activities and programs of the several departments and agencies of the National Military Establishment. Each of the three Services operated its own research and development program.

A reorganization was initiated in the Department of Defense by President Eisenhower under the Presidential Reorganization Plan No. 6 of 1953, which grew out of the Report of the (Nelson) Rockefeller Committee on Department of Defense Organization. This plan was submitted to the Congress on April 30, 1953, with a message from the President which enumerated three objectives to be achieved by this reorganization:

1. Clarify line of authority so as to strengthen civilian responsibility.
2. Achieve effectiveness with economy.
3. Improve our machinery for strategic planning.

The result of this reorganization is shown on an accompanying chart, which reflects the organization of the Department of Defense at this time. In place of the Research and Development Board, there were created two Assistant Secretaries of Defense—an Assistant Secretary of Defense (Research and Development), and an Assistant Secretary of Defense (Applications Engineering)—and an Assistant for Atomic Energy. Directives issued in 1953 by the Secretary of Defense defined the functions of the two new Assistant Secretaries. Donald A. Quarles (now Secretary of the Air Force) was the first Assistant Secretary of Defense (Research and Development) (R&D) and Frank D. Newbury, the first Assistant Secretary of Defense (Applications Engineering) (AE). On December 5, 1955, Dr. Clifford C. Furnas was sworn in as the successor to Mr. Quarles.

Organization chart of the Department of Defense. The Assistant Secretaries of Defense serve in staff capacities; the military services and their contractors have the real responsibility for research and development.


SECRETARY OF DEFENSE
DEPUTY SECRETARY OF DEFENSE
ARMED FORCES POLICY COUNCIL
SPECIAL ASSISTANTS (as designated)
JOINT SECRETARIES
ASSISTANT SECRETARY OF DEFENSE (Comptroller)
ASSISTANT SECRETARY OF DEFENSE (Manpower and Personnel)
RESERVE FORCES POLICY BOARD
GENERAL COUNSEL
ASSISTANT SECRETARY OF DEFENSE (Legislative and Public Affairs)
ASSISTANT SECRETARY OF DEFENSE (International Security Affairs)
JOINT CHIEFS OF STAFF
ASSISTANT SECRETARY OF DEFENSE (Research and Development)
ASSISTANT SECRETARY OF DEFENSE (Applications Engineering)
ASSISTANT SECRETARY OF DEFENSE (Supply and Logistics)
ASSISTANT SECRETARY OF DEFENSE (Properties and Installations)
ASSISTANT SECRETARY OF DEFENSE (Health and Medical)
ASSISTANT TO THE SECRETARY (Atomic Energy)
COMMAND LINE
MILITARY DEPARTMENTS
DEPARTMENT OF THE ARMY
DEPARTMENT OF THE NAVY
DEPARTMENT OF THE AIR FORCE

The line of command in the Department of Defense today is directly from the Secretary of Defense to the three secretaries of the military Services. These Services are still individually responsible "for planning and executing sound departmental technical programs, sound in relation to the state of the art, the military needs, available resources, and the programs of the other military departments." The two Assistant Secretaries of Defense are responsible "for reviewing their respective portions of these three programs to see that they are well-coordinated and that, collectively, they constitute a sound and integrated over-all Department of Defense program."

Fields of Interest Outlined

There has been some question, understandably, with regard to where research and development leaves off and applications engineering begins. This was anticipated at the time the positions for the two Assistant Secretaries of Defense were established. The following broad outline was provided at that time:

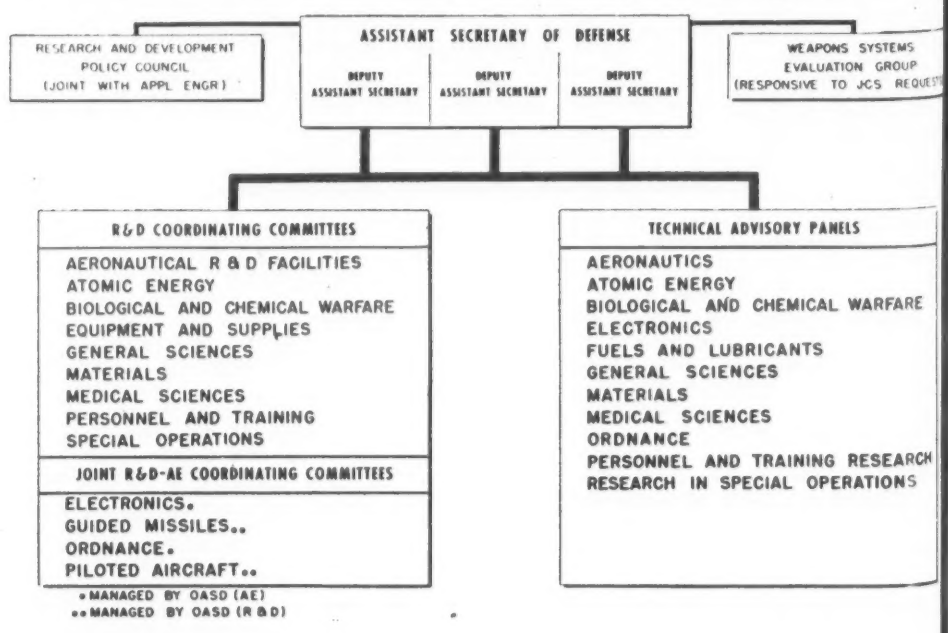
> "Where advanced technology or new art is involved, such as new electronic systems, research and development, as referred to herein (outline of responsibilities), begins with basic and exploratory research and extends through successful laboratory and engineering field tests of prototypes, together with systems and evaluation incidental to such development. Where the art is well established, or parallels closely civil design, such as heavy mechanical equipment in general, research and development will be limited to exploratory work through the research or breadboard model phases and cognizance will pass to applications engineering at the stage where design of a military item can be undertaken."

The R&D organization of the Department of Defense today has three major divisions: (1) a Research and Development Policy Council; (2) Coordinating Committees; and (3) Technical Advisory Panels.[1]

The Research and Development Policy Council consists of the Assistant Secretary (R&D) as chairman, the Assistant Secretary of Defense (AE), the Deputy or Deputies Assistant Secretaries of Defense (R&D) and (AE), the Assistant Secretary (or equivalent) of each Military Department with responsibility for Research

[1]On March 27 this year, Secretary Wilson announced the appointment of Mr. Eger Murphree as a Special Assistant for Guided Missiles. He is to be "responsible for direction and coordination of research, development, engineering and production of guided missile activities."

Organization chart of the Office of the Assistant Secretary of Defense (Research and Development). Coordinating Committees and Technical Advisory Panels are staff groups to help the R&D office achieve "sound, coordinated and integrated programs."



and Development and/or Applications Engineering, and the senior military officer(s) of each Department with responsibility for these areas.

Each of the coordinating committees covers an assigned area of the military technical program—Research and Development and Applications Engineering. In general, each committee consists of a representative of each of the three military departments and of the Office of the Assistant Secretary of Defense for R&D, and of the Office of the Assistant Secretary of Defense for AE. These committees serve in staff capacities.

Finally, Technical Advisory Panels, consisting in general of consultants selected for their special competence in the fields of science and technology involved, advise the cognizant coordinating committees.

The scope of the coordinating committees is indicated by the field of interest of the Joint Coordinating Committee on Electronics. It is a joint R&D-AE group, managed by the Office of the Assistant Secretary of Defense for AE. This committee concerns itself primarily with electronic equipment, devices, techniques, and procedures, including (1) communications, (2) acoustics, (3) electronic countermeasures, (4) infrared, except as part of aircraft systems or guided missile systems, (5) electronic test-equipment programs, as such (6) electronic components, (7) semiconductors, (8) electron tubes,* (9) antennas and propagation, (10) interference reduction, (11) data handling, (12) underwater sound, and (13) all radar not covered by other committees. In addition, this committee is responsibile for advising other committees on the integration of electronic equipment and devices into weapons systems.

In August 1955, the Electronic Test Equipment Coordination Group was established to assist the Joint Coordinating Committee on Electronics. Five Working Groups in this test equipment coordination program were set up in February of this year. They are the Working Groups on Signal Generating Test Equipment; Frequency, Time, and Waveform Measuring Equipment; Power and Impedance Measuring Equipment; Voltage and Current Measuring Equipment, and Miscellaneous Test Equipment.

Recommendations to Clarify Responsibilities

The Coordinating Committees and Technical Advisory Panels were established in 1954 in a further attempt to clarify the relationships of the two Assistant Secretaries. While commending that action, the Hoover Commission in its May 1955 report recommended that DOD consider combining the functions of R&D and AE and have one Assistant Secretary administer the two areas.

In continued recognition of the responsibilities of the individual military services, the Hoover Commission further recommended that an Office of Assistant Secretary for Research and Development be established in each of the three military departments. This has been accomplished in both the Army[2] and Air Force, but not as yet in the Navy, where research and development is a part of the responsibility of the Assistant Secretary of the Navy for Air.

With the Navy, however, the Office of Naval Research was established by the 79th Congress in 1946, "to provide within the Department of the Navy a single office, which, by contract and otherwise, shall be able to obtain, coordinate, and make available to all bureaus and activities of the Department of the Navy, world-wide scientific information and the necessary services for conducting

[2]The Army position is entitled "Director of Research and Development."

Secretary of Defense Charles E. Wilson congratulates Dr. Clifford C. Furnas after he was sworn in as Assistant Secretary of Defense (R&D) at the Pentagon on December 5, 1955. Dr. Furnas succeeded the first R&D Assistant Secretary, Donald A. Quarles, after he was named Secretary of the Air Force.

specialized and imaginative research," etc. ONR was also charged with "the conduct of naval research in augmentation of and in conjunction with the research and development conducted by the respective bureaus and other agencies and offices of the Navy Department," etc. More recently, ONR was assigned the responsibility for staff coordination of development work of the Navy's seven technical bureaus. The Chief of Naval Research reports to the Assistant Secretary of the Navy for Air.

In the Air Force, all operations of research and development are the responsibility of the Air Research and Development Command, established in 1950 as a result of the Ridenour Report of the Air Force Science Advisory Board. With present headquarters in Baltimore, ARDC has eleven centers distributed across the Nation. A small staff for plans, programs, and direction is maintained by a Deputy Chief for Research and Development within the Air Staff of the Chief of Staff.

Technical Information Agencies

That, in brief, then, is the story of the R&D organization within DOD and how it came about.

In conclusion, however, two further agencies are worthy of mention, since they make available the scientific information which results from research and development. One of these is the Armed Services Technical Information Agency (ASTIA), with headquarters in Dayton, Ohio. ASTIA was set up in 1951 to provide "technical information and related services to the military departments and other agencies of the Department of Defense and Department of Defense contractors." The Secretary of the Air Force was assigned the responsibility for the administration and operation of this agency in early 1955.

And within the Department of Commerce, the Office of Technical Services makes Government (not only Department of Defense) technological information available to businessmen and the general public. As an idea of the scope of this service, more than a quarter of a million individual reports, including unclassified Atomic Energy Commission reports, are indexed and on file at OTS in Washington.

IN THE PALM OF HIS HAND

. . . a complete military transmitting and receiving station weighing about one pound!

The "battle maneuvers" illustrated above disclose a new dimension in military communication, made possible by modern transistor developments.

In his hand the officer holds an RCA Transceiver, a complete radio transmitting and receiving unit—the smallest 2-way FM radio ever built. The entire walkie-talkie is only 6" x 3" x 1⅛" in size, with weight, including battery and all accessories, of about 20 ounces.

The men in the field listen to "battle instructions" over tiny receiver units built inside their helmets.

With a range of about a quarter mile, the RCA Transceiver can be pre-set for any frequency between 45 and 52 mcs. Only two controls are used and no tuning or adjustment is necessary during normal use. The receiver is an all-transistorized superheterodyne and the transmitter comprises two transistors and one tube, both contained in a single unit.

The feather-lightness and miniature size of the transceiver and receiver make it possible, for the first time, to extend communication to the individual level. It is another instance of RCA's constant search for new and better ways of doing things electronically. Demonstration and consultation with RCA field engineers throughout the world are invited. Call or write.

RCA Ultra-Miniature FM Transceiver compared with AN/PRC-10 (Walkie-Talkie)

TYPICAL MILITARY APPLICATIONS

- Tactical communications between squad and platoon leaders and higher, also with individual soldier or marine
- Military police and sentry duty
- Air and sea rescue (unit in survival kits)
- Guided missile installations (before and after take-off)
- Communications between maintenance crews, fire crews and between crew and control tower

Medical work (litter bearers to field hospitals) *. . . and hundreds of others.*

DEFENSE ELECTRONIC PRODUCTS

RADIO CORPORATION of AMERICA

CAMDEN, N. J.

Standard radio frequencies, time announcements, and audio frequencies are a few of the services broadcast to the world from NBS radio station WWV, located near Washington, D. C. An interior view of the station shows four high-powered radio transmitters, each of which broadcasts one radio carrier frequency.

Physical Standards for the Electronics Industry

by Dr. Allen V. Astin
Director
National Bureau of Standards

IN THE PAST TEN YEARS, THE American electronics industry has undergone a most phenomenal growth—a growth which has hardly been duplicated in the annals of American economics. It has been estimated that more than six billion dollars worth of electronic equipment and apparatus was manufactured in this country during 1955. This amazing rise in production shows great promise of continuing; more and more, we are finding new uses for electronic devices and techniques.

One of the important factors supporting this growth is the development of standards of physical measurement which assures the interchangeability of components having specific physical characteristics. The electronics industry, like other industries, has turned to mass production. This means the large-volume production of components, parts, and circuits. It means, furthermore, that these parts, which may be manufactured by several makers, must be produced with sufficient precision and uniformity so as to be fitted into a whole. *And whenever precision and uniformity are required of a product, there is the necessity for standards whose precision exceeds production requirements.*

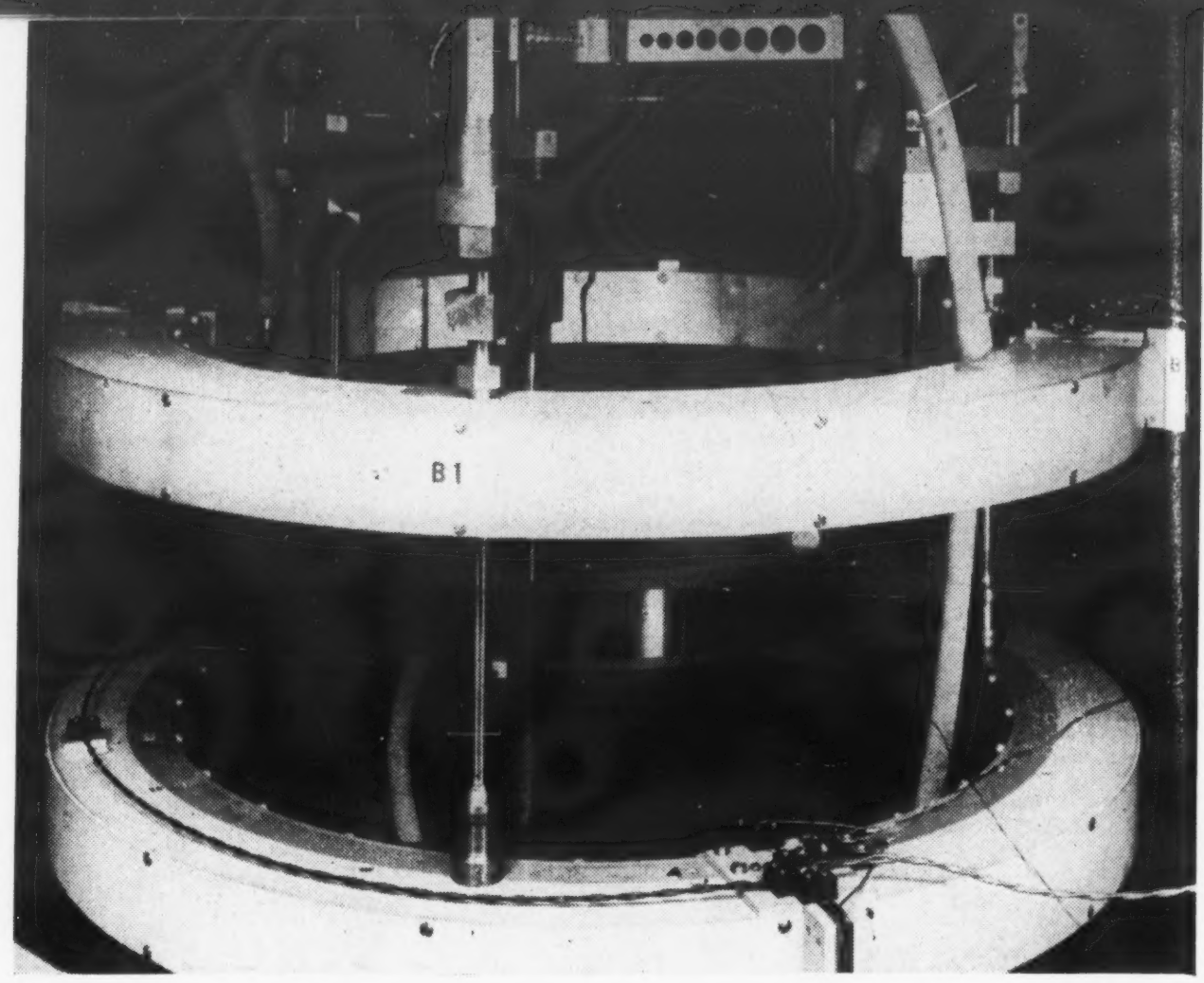
Need for Uniformity

Effective use of electrical and electronic equipment requires a high degree of precision in the uniformity of operating characteristics. Were each manufacturing company to use even a slightly different value for basic electrical units, such as the volt or the ohm, the apparatus made by subcontractors would fail to function at full effectiveness as a part of the final product. The result would be an impossibly confused situation causing large financial losses to the Nation.

In the communications industry, for example, multiplex transmission of intelligence over a relatively small number of circuits is dependent on the precise adjustment of capacitors, inductors, and other circuit components in such a way as to prevent the signals from straying into the wrong channels. This requires great uniformity in the measurement of the basic electrical units.

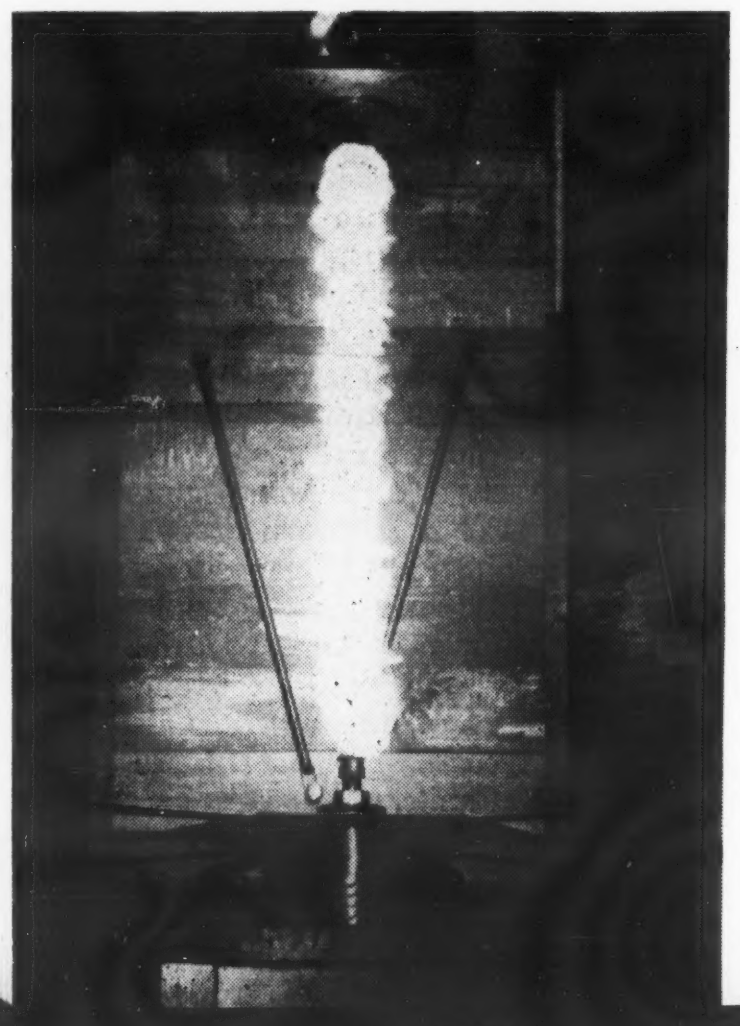
The precise and accurate measurement required by modern technology can be achieved only by periodic comparison of working standards with primary standards and by periodic calibration of measurement instruments with reference to primary standards. Each year the demand for the calibration of electrical and electronic instruments increases. Because of the technical difficulties of achieving this critical uniformity of operating characteristics, precise, absolute measurements are carried out only in the national standardizing laboratories of a few of the larger countries. These absolute measurements serve as the "standards" for all other measurements made in industrial and scientific laboratories.

As the custodian of the national standards of physical measurement, *the National Bureau of Standards has the responsibility of insuring that the units of measurement used in science and industry are constant through the years and uniformly available throughout the nation.* In carrying out this responsibility in the fields of electricity and electronics, the Bureau has developed very precise standards of resistance and voltage whose values are established by absolute measurements that fix the relation between these units and the fundamental mechanical units of length, mass, and time. From these basic electrical standards, the Bureau derives other standards for the many electrical quantities in use today.



Coils of the current balance used at the National Bureau of Standards to "weigh" current for the absolute determination of the ampere. The smaller coil is suspended, coaxial with the two larger coils, from the pan of a sensitive balance. When a current flows through all three coils in series, the mechanical force between the small and large coils is measured with the balance. From the value of this force and the mechanical dimensions of the coils, the absolute value of the ampere is computed.

Here, a 100,000-ampere current surge is measured during discharge by means of a coaxial tubular shunt developed at NBS. Current magnitude is determined from the characteristics of the voltage drop across the shunt as recorded on a high-speed cathode-ray oscillograph.



The demands of modern science and technology have made this work more and more exacting, not only in terms of accuracy but also in terms of the range of values and variety of units in which measurements are made. To meet these demands, the Bureau conducts a variety of research and development projects whose combined objective is the provision of more and better standards in the field of electronics. These projects are undertaken by three of the Bureau's technical divisions: The Radio Standards Division; The Electricity and Electronics Division; and The Data-Processing Systems Division.

Research Conducted by Radio Standards Division

The Radio Standards Division is located in Boulder, Colorado, and is a part of our recently established Central Radio Propagation Laboratory. This division is responsible for basic research and development leading to new and improved radio standards, measurement techniques, and associated instruction for all radio frequency and microwave electrical quantities. It is also responsible for supplying the national primary radio standard and calibration services.

In addition to these reference calibrations, the division operates continuous night-and-day broadcasts from stations WWV in Maryland and WWVH in Hawaii which provide standard frequency, audio frequency and time signals. These signals are used by broadcast stations to keep their transmitters in channel, by manufacturers of electronic equipment to calibrate such items as oscillators and television tuners, and by electric power companies to control the 60-cycle-frequency of their generators.

All of these services, of course, must be supported by an extensive research and development program in order to provide standards in the newly opened region of the electromagnetic energy spectrum and to keep the accuracy of the standards ahead of the steadily advancing precision of radio sciences and industry. We are hoping to expand this program and to step up research and development activities on radio frequency and microwave properties of matter and the measurement of fundamental physical constants using radio techniques.

This year the Congress has appropriated funds for the construction of an electronic calibration center at Boulder, Colorado. This facility will be equipped and put into operation during the coming year. It will pro-

vide calibration services for electric and electronic instruments that measure voltage, current, power, attenuation, impedance and other quantities at frequencies ranging from 0 to 40,000 megacycles.

This new center will serve primarily the needs of military agencies by providing a primary standard calibration service for electronic instruments to be used by the Army, Air Force, and Navy in acceptance testing and in maintenance of reliability of electronic gear.

The need for such a service has been expressed in recent years by industrial and university laboratories. Although manufacturers of electronic equipment have attempted to fill the gap created by the Bureau's inability to provide these services by establishing procedures to calibrate their own working standards, these working standards lose much of their value if they are not calibrated in terms of the national primary standards so that, for example, several contractors for particular types of electronic components will produce interchangeable equipment. We are happy to see that this electronics calibration center has been authorized and are eager to see it in full operation. This center will not only provide the needed service to defense agencies, but will also be of great value to the electronics and communications industries.

Electricity & Electronics Division

The Electricity and Electronics Division bears the major responsibility for the basic electrical units from which the radio standards are derived and for research and development of standards for electronics. In addition to its work on standards and testing in the field of electricity, the division is concerned with the fundamentals underlying the development and manufacture of electron tubes, transistors, and related devices.

The work of this division has had considerable influence on the progress of electronics, especially in the development of methods of tests of apparatus and in research and development on systems, designs, components, and fabrication processes. While we have, in the past few years, attempted to undertake work on standards for the electronics field, most of our effort heretofore has been in the development of devices and techniques as required by other laboratories and agencies of the Government.

We recognize that there is an expanding need by industry and science for increased work on electronic standards by the National Bureau of Standards. Accordingly, we propose and are embarking upon a coordinated program of electronics research and development, including the extension of our information service on electronic components. We feel that we have a unique responsibility for such a program to support this relatively new technology.

Let me describe our proposed program on electronic standards:

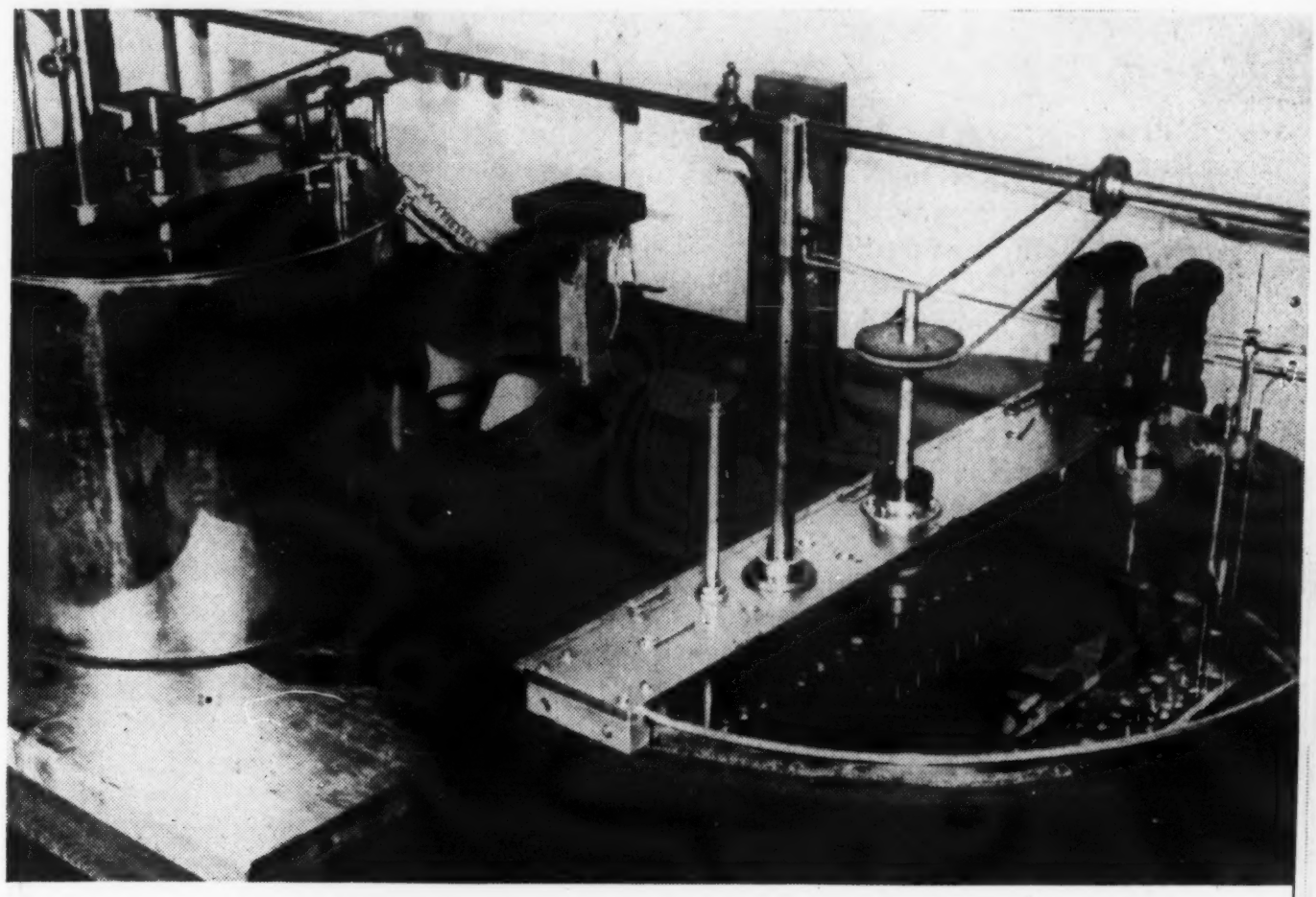
Electronic components are specified by certain electrical parameters which describe performance. To keep all laboratories on a common footing, it is necessary to work out standardized methods of measuring these parameters, and equally important, to decide what parameters should be so standardized. In the case of radio receiving tubes, this has been accomplished by a slow trial-and-error process as the industry grew.

Transistors Bring Problems

The introduction of transistors into an already established industry presents the possibility of a similar slow hit-and-miss approach. To avoid such waste and confusion, standards of practice need to be worked out as rapidly as possible. The Bureau hopes to serve as the focal point for industry and Government to agree upon these standards of measurement.

In addition to performance parameters, there are also other characteristics of electronic components which profoundly affect their military and industrial applications. These are useful life and reliability. The importance of reliability of electronic systems to national defense is, of course, fully recognized. However, a *major deterrent to the elimination of non-reliable components is the lack of suitable standards for measuring and evaluating reliability* (see "Quotes in Review," Mr. Bridges, Page 58 Ed.) With the advent of transistors, a similar situation can well arise. The Bureau hopes to provide its services as an unbiased agency seeking to determine factors affecting life and reliability and to work out measurement techniques which will lead to efficient acceptance tests.

Certain phases of the electronic art have reached a stage of common practice in which elementary circuit configurations appear as common elements in numerous equipments. Yet, although the elements are common, the specific design varies with the design engineer. This may result in a large and costly increase to maintain supplies of repair parts which could exceed the cost of the original equipment. By standardizing



The volt, basic unit of electromotive force, is maintained at NBS by means of standard reference cells whose voltage is constant and accurately known. For comparison tests, groups of cells are kept at constant temperature in thermostatically controlled oil baths, primary standards in the smaller bath (left) and cells for certification (right). A saturated solution of cadmium sulfate serves as the electrolyte. The electromotive forces of these cells are compared periodically with those of similar standard groups from various foreign governments.

the common, well-developed, much-used elementary circuits, vast savings in production, logistics, and engineering talent can be made. With the cooperation and support of the Navy's Bureau of Aeronautics, the National Bureau of Standards has made a good start on this problem. It is hoped that the effort may soon be enlarged.

Consistent with this planned expansion in the standards program, the Bureau also hopes to extend its information services on electronic components. The Government and the public both need a ready source of numerical and other information on various phases of electronics. It is important that such a service be unbiased by commercial considerations.

Tube & Transistor Service

The National Bureau of Standards now conducts a tube and transistor service which collects and makes available to the Government and to the public information on electron tubes, transistors, and similar devices produced throughout the world. This service, which is not paralleled elsewhere, has been successfully operated by the Electricity and Electronics Division for several years and is widely used.

The success and importance of this tube information service leads us to hope that a similar service covering the materials used in the fabrication of electron tubes and transistors may also be established. It is desirable in this case that the National Bureau of Standards not only collect information from all available sources but that it also conduct research in those cases where it is realized that gaps exist.

This apparatus for measurement of electrical power in the range 300 to 3,000 megacycles is used to investigate and develop microwave power measurement equipment and techniques as part of the Bureau's program to establish national standards and calibrations for all electrical quantities at microwave frequencies.

A third information service which is under consideration relates to materials used in electronic circuit components such as resistors and capacitors and in so-called printed circuits. This third service is still far from being established, but its value to systems development is fully appreciated.

The Data-Processing Systems Division is also a relatively new part of our organization; it has a more limited, but nonetheless vital, interest to scientists and engineers in the electronics field. The staff of this division is made up of electronic scientists and engineers who, because of their early experience in computer research and computer systems, have been collected into one major organizational unit of the Bureau. This was done in order to exploit their talents as a specialized group, to encourage them in this rapidly growing field, and to provide an experimental and advisory center to the Government on computer developments and data processing systems and techniques.

The work of this division may be divided into two parts. On the one hand, they help other Government agencies to analyze their data handling problems in terms of how these problems may be solved by applying automatic electronic techniques. On the other hand, they conduct extensive research on automatic systems, basic circuitry, systems components, and auxiliary equipment. They also develop methods of testing systems and components.

The potentialities of automatic control for business and industrial operations are still largely unexplored. These automatic techniques, however, promise to become important factors in future management and production processes. The application of these techniques to Government operations will provide for large-scale efficiencies and economies. To a large extent, these applications depend upon further developments in the field of electronics.

NBS Research Has Far-Reaching Effects

Finally, a few words should be written about the relation of the electronics projects which the Bureau undertakes for other Government agencies, especially agencies of the Department of Defense, to the electronics industry in general. It is recognized, I feel sure, that defense-sponsored research has served to further scientific activity in general. The projects which the Bureau has undertaken to help meet these specific military requirements have also yielded data and techniques which have wide value. The data resulting from these specialized studies have been carried over into non-military projects where they have served in uses which are quite distant from the originating projects. Thus, although the new electronics calibration center which the Bureau will activate next year may have its justification in the urgent demands of the military agencies, there can be little doubt that this center will also help to service the needs of industry.

Standard watthour meter setup at the National Bureau of Standards. In the foreground (l to r) are: the "standard watthour meter" in its circular housing, the pulse counter and electronic timing and counting circuits which determine accurately the duration of a test run, and the AC power supply which energizes the coils of the standard or the watthour meter under test.

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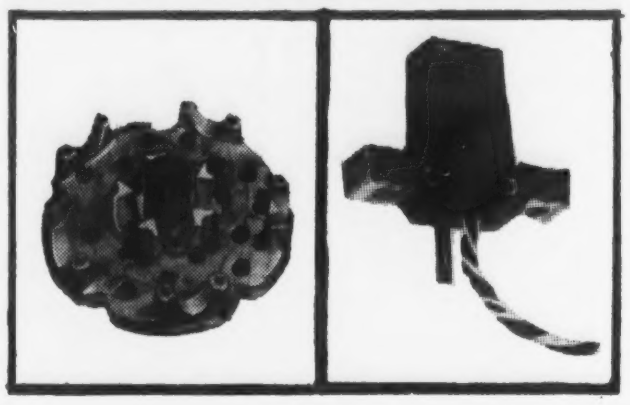

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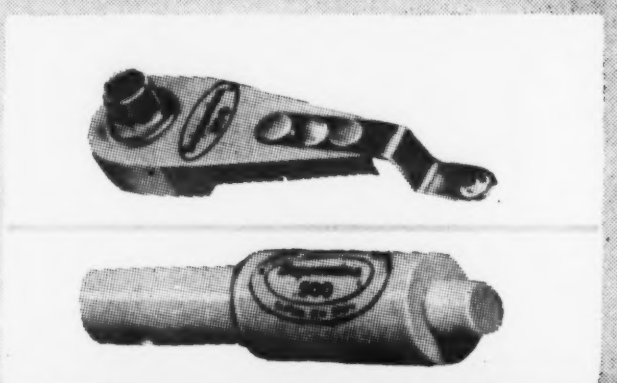
TYPICAL APPLICATIONS



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IMAGINATION AND BOLD THINKING AT THE ALDEN RESEARCH CENTER

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In anticipation of the tremendous possibilities from direct graphic recording and high-speed facsimile made possible by Alfax paper, a full-scale program to develop the needed equipment and processes was put into operation. By the time the Armed Forces and industry had grasped the full import of these advances, many of the anticipated problems had been solved. During this time operations and equipment had been kept under wraps until the prototype had become the mass production design and reasonable time was provided for field testing equipment in each and every field of probable use. These years of research and preparation have culminated in exclusive equipment techniques and designs while the development of advanced methods of manufacture and production has provided a strong foundation for design and production expansion at the Alden Research Center.

Equipment is built in straight-line production manufacture using the Alden Work Center System. This system permits production to be built up in straight line from the most efficient unit process into integrated production lines. Equipment and processes are adapted into pre-fabricated layouts to provide all the required combinations for quality control and top volume production.

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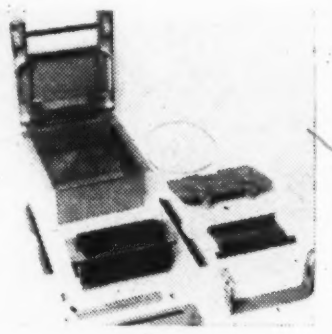
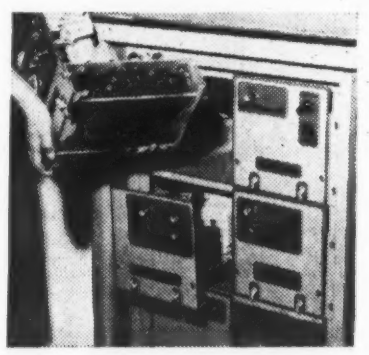
New concepts of design and servicing were necessary to meet the requirements of the many broad interests involved. Components had to be simple, compact, and easy to service so a system of unitized, plug-in construction was developed for both mechanical and electronic components.

Mechanically, recorder components are divided by function into individual, self-contained units. To service or change a function, merely unfasten target screws with a coin and remove unit. When component units are re-installed, they automatically make electrical contact and are ready for operation.



Electronics are divided in much the same way. Function by function, they are arranged on plug-in terminal cards mounted in vertical planes of circuitry. To service, simply slide out old chassis and slide in a spare while it is being repaired, thus making it unnecessary to keep equipment out of operation for more than a minute.



The result is completely integrated equipment designed for: simple "on the spot" installation, virtually trouble-free, unattended operation, and "on the spot" servicing of "building block" components.

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Small Business "Partners in Progress"

by Donald A. Hipkins

ANY DISCUSSION OF THE THEME OF YOUR 10TH ANNUAL convention, "Military and Industry: Partners in Progress," must necessarily include those members of industry who fall within the category of small business. They are, in fact, the backbone of American industry and their contributions to the progress of the Nation are legion. History has recorded the outstanding performance of small business concerns in helping to provide the equipment and materiel necessary to the successful prosecution of two World Wars and the conflict in Korea. The contributions by small business toward the technological progress of the United States are likewise matters of record.

The Small Business Administration plays a vital role in preserving a climate within American industry which will make it possible for small business to continue to contribute to the progress of our Nation. The Small Business Administration is one of the independent agencies of the Federal Government which report directly to the President. It is the first peacetime agency ever established to provide assistance to all types of small businesses.

Congress Prescribes Basic Policy

In creating the Small Business Administration on July 30, 1953, without a dissenting vote, the Congress in Public Law 163, 83rd Congress, expressed its will in no uncertain terms. In Public Law 268, 84th Congress, the original Act was amended and strengthened. The following are basic concepts and declared policies of the Congress which led to the establishment of the Small Business Administration and which govern its operation:

That "The essence of the American economic system . . . is free competition."

That "Only through free competition . . . can opportunities for the expression and growth of personal initiative and individual judgment be assured."

That "The preservation and expansion of such competition is basic not only to the economic well-being but to the security of this Nation."

That "Such security and well-being cannot be realized unless the actual and potential capacity of small business is encouraged and developed."

That ". . . the Government should aid, counsel, assist and protect insofar as is possible the interests of small-business concerns . . ., to insure that a fair proportion of the total purchases . . . for the Government be placed with small business enterprises and to maintain and strengthen the over-all economy of the Nation."

The Small Business Act then prescribes the four basic missions assigned to the Agency:

1. To make loans to small business concerns, not in excess of $250,000 to any one borrower.
2. To make loans to victims of floods or other catastrophes and to business concerns in drought areas.
3. To insure that a fair proportion of the total purchases and contracts for supplies and services for the Government is placed with small business concerns.
4. To provide technical and management assistance to small business concerns.

In order to provide maximum service to the small business community of the United States, SBA Regional Offices are operated in the following cities:

Boston, Massachusetts	Chicago, Illinois
New York, New York	Minneapolis, Minnesota
Philadelphia, Pennsylvania	Kansas City, Missouri
	Dallas, Texas
Richmond, Virginia	Denver, Colorado
Atlanta, Georgia	Seattle, Washington
Detroit, Michigan	San Francisco, California
Cleveland, Ohio	Los Angeles, California

SBA Branch Offices are located in:

Syracuse, New York	Madison, Wisconsin
Hartford, Connecticut	Davenport, Iowa
Pittsburgh, Pennsylvania	St. Louis, Missouri
Baltimore, Maryland	Little Rock, Arkansas
Charleston, West Virginia	New Orleans, Louisiana
Charlotte, North Carolina	Houston, Texas
Birmingham, Alabama	Oklahoma City, Oklahoma
Memphis, Tennessee	Wichita, Kansas
Miami, Florida	Omaha, Nebraska
Louisville, Kentucky	Helena, Montana
Indianapolis, Indiana	Portland, Oregon

Historical Background of SBA

At this point it might be in order to provide some of the historical background which led to the establishment of the Small Business Administration. The Congress has long been aware of the many problems which confront the small business man in operating his business with a limited staff and in competing with big business. In 1941, a Small Business Division was established in the Department of Commerce to assist the small business man with his management and technical problems.

With the advent of World War II, the Congress established the Smaller War Plants Corporation. About the time of the Korean conflict the Congress abolished this Agency and established the Small Defense Plants Administration. This latter agency absorbed the programs of the Small Business Division of the Department of Commerce, was given the added function of obtaining defense contracts for small business, and of recommending to the Reconstruction Finance Corporation the granting of loans to small business concerns.

As stated before, the Congress, on July 30, 1953, abolished the Small Defense Plants Administration and established the Small Business Administration. In the same bill, the Congress abolished the Reconstruction Finance Corporation and authorized the Small Business Administration to make loans to small business concerns

and to victims of floods and other catastrophes.

The Small Business Administration thus came into being with greatly expanded functions over any of its predecessors, viz.:

1. It was charged with the duty of serving the entire small business community of the Nation, not just those engaged in defense activities.

2. It was authorized to make loans to small business concerns and to disaster victims.

3. It was directed to see that a fair proportion of all *Government contracts (not just those for defense work) went to small business concerns.*

Business and Disaster Loan Assistance

The Small Business Administration takes pride in its accomplishments over the past two years and eight months. During that period we have granted 2,789 loans valued at approximately $135,221,000 to small business concerns. Approximately 66⅔ percent of the loans were made in participation with banks and other lending institutions. Business loan applications have increased from

Donald A. Hipkins
Deputy Administrator for Procurement and Technical Assistance, Small Business Administration

220 in December of 1955 to over 500 in March of 1956. In addition to business loans, we have made 4,025 loans valued at $47,234,000 to victims of disasters. These occurred mainly in the Carolinas and New England as a result of the hurricanes of last fall, and in California, Oregon and Nevada, as a result of floods in December 1955. Financial specialists are always available in our field offices and in the Washington office to assist and advise the small business man with his financial and related problems.

In the fields of procurement and management and technical assistance, the Small Business Administration has likewise assisted the small business men of the country to participate as "Partners in Progress." Through agreements with the procuring agencies of the Government, we have set aside nearly one billion dollars worth of contracts for *exclusive* bidding by, and award to, small business concerns. The following figures are indicative of assistance rendered in the procurement area, in addition to the foregoing:

Prime Contract Referrals to small firms	317,670
Subcontracting Referrals to small firms	22,169
Counseling and representation to procurement agencies in behalf of small firms	47,846
Assistance to bid on specific procurements	7,309

One other phase of our procurement assistance programs involves the issuance of "Certificates of Competency." An application for a certificate is made by a small business concern when it is low bidder on a Government contract, and for reasons of finance or productive capacity, the contracting office does not believe the concern can perform. If after a thorough investigation, we determine that the applicant can perform the contract in question, a "Certificate of Competency" is issued. The Government procuring agency is then required to award the contract to the applicant. More than 155 such "Certificates" have been issued resulting in contracts of approximately $20,000,000 being awarded to small companies.

In the field of publications, we have distributed on request and at no charge approximately 2½ million copies of various "Management," "Technical" and "Small Marketers Aids." In addition, approximately 500,000 other SBA publications have been sold through the Government Printing Office. Outstanding among the latter is a "U. S. Government Purchasing Directory." This directory lists the items bought by Government military and civilian agencies, and lists the names and locations of the purchasing offices which buy them.

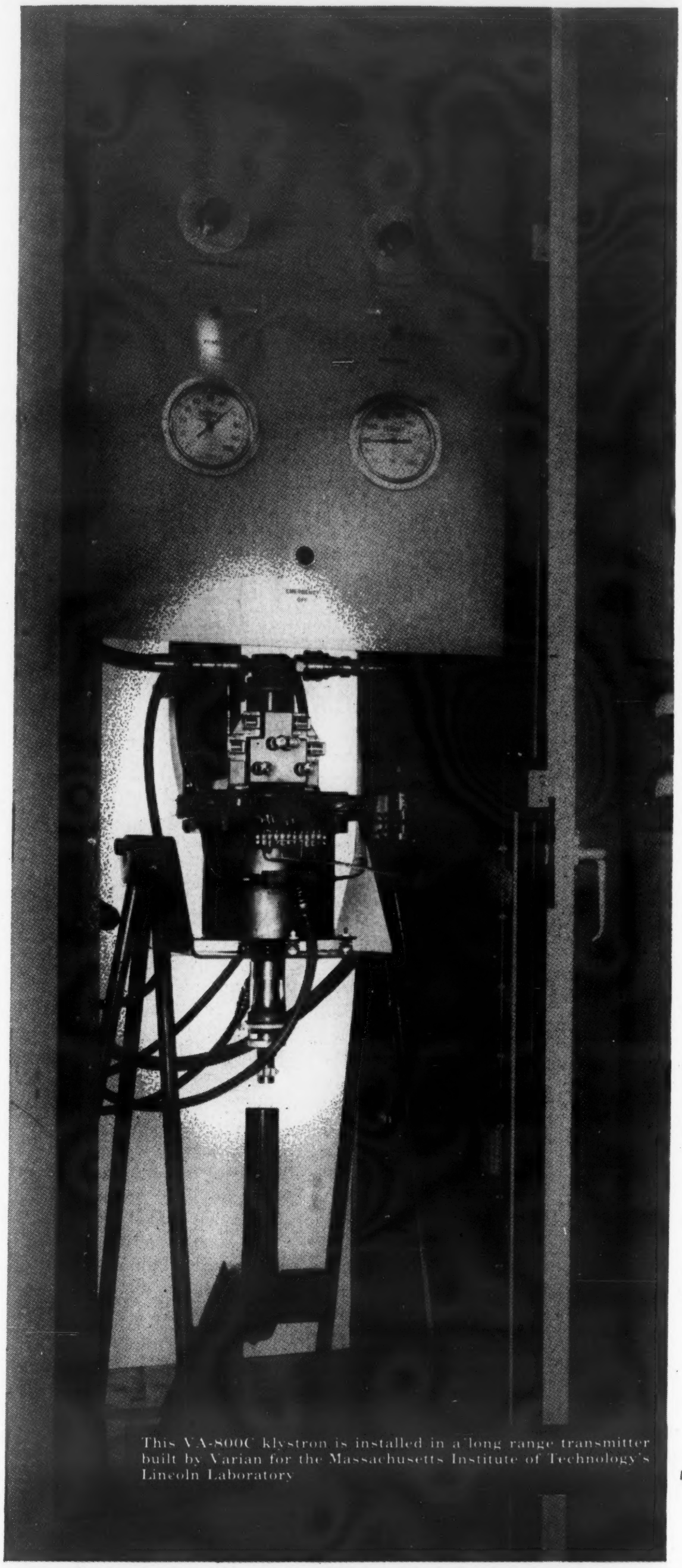
SBA Co-Sponsors Courses in Administration Management

We are particularly proud of a small but efficient group in our Agency that is responsible for encouraging administrative management courses and issuing management publications. A study made during 1953 by the Chamber of Commerce stated that the primary problem of small business and the predominant reason for their high rate of failure was the lack of adequate management. This conclusion has been reached by many competent students of small business and the statement is made that about 9 out of 10 business failures are due to inefficient or incompetent management. While it may be that the immediate cause of most failure is the lack of capital, underlying the financial difficulties is usually a more basic problem—inadequate or incompetent management.

In cooperation with universities and other educational groups throughout the Nation, the SBA is co-sponsoring short courses in administrative management for small business owners and directors. These courses are designed to help the small business operator to improve his knowledge of business administration and are concerned with management policy having to do with organizing, staffing, planning, directing and controlling.

While the results of these courses can be judged directly only by the evaluations from the businessmen who take them, and these evaluations have been favorable, *I believe that this inexpensive program can be one of the most significant in the efforts of this Administration to strengthen the over-all position of small business.* To date approximately 100 of these courses have been conducted and over 4,000 small business executives have attended them.

The foregoing is but a brief summary of the operation of the Small Business Administration, an operation designed and functioning to render all possible assistance to the small business community of the United States. Our services are at your disposal. We have no magic formula for solving all of your problems. We do have a willingness to help, a vast store of pertinent information, and many avenues open to us to render assistance in specific cases. Our services are available to all small business men who want to be "Partners in Progress."



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TACAN

a brief description of the new military short distance air navigation aid

by Commander William W. Bush, Jr., USN
Navy Representative
Air Navigation and Development Board

THE U. S. AIR FORCE AND NAVY are today installing a new short distance air navigation aid at major bases, along selected air routes, and aboard Naval ships. Simultaneously, large numbers of airborne units are being procured for installation in military aircraft. This navigation system is known as TACAN. The word "TACAN," a typical short title, means "*TAC*tical *A*ir *N*avigation."

Like most recent U. S. navigation systems, TACAN is a Rho-Theta system. Briefly, it is a system of radio navigation which provides aircraft with accurate distance (Rho) and bearing (Theta) information, with respect to a selected ground station. The equipment operates in the 960-1215 megacycle band and provides 126 crystal-controlled two-way channels with a capacity of over 100 aircraft each. Both functions, bearing and distance, are transmitted over the same channel, the bearing information being amplitude modulated upon the output of a constant duty cycle distance measuring pulse transponder. The ground equipment is packaged for fixed shore installation, shipboard installation, or in a compact trailer for ground mobile use. The airborne equipment in its current military form is packaged in a box roughly 10¾" x 8" x 18" and weighs about 56 pounds.

Prototype Built in 1950

The TACAN system being installed today was conceived shortly after the close of World War II. The Navy had a requirement for a navigation system to replace the wartime homing system YE/YG. Various navigation systems were planned around this requirement and *the basic military requirement to fly all sizes of high performance aircraft in all airspace in all weather conditions.* The planning that resulted in TACAN was done jointly by the Navy and the Federal Telecommunication Laboratories. Navy contracts with FTL developed, and prototype TANCAN equipment that met Navy requirements was built by 1950.

Unfortunately, in 1950, certain unpleasant facts regarding the world in which we live were becoming increasingly apparent. The instruments of war had attained such a capacity for destruction and such speed and radius of action that any point on earth could be considered for destruction within a matter of hours. Nations unfriendly to the United States possessed these instruments and estimates as to when they would be capable of employing them ranged from right then to dates in the not too distant future.

In the face of these facts, it was decided that all military aircraft should have a common navigation system and TACAN was selected as the military short distance system. Furthermore, with the United States a potential scene for air battle, tactical systems would have to be more extensively implemented here at home. TACAN was redesigned to meet these new and greatly increased requirements. The major change involved more than doubling the channel capacity to 126.

The military was now faced with a large scale implementation of TACAN in the United States. Brief consider-

A typical example of "Partners in Progress" is the recently announced TACtical Air Navigation system. Developed and built under Navy contract with industrial concerns, the system is presently being used in Navy and Air Force installations and, rounding out the "partnership," being considered for commercial aircraft.

ation was given to proposing TACAN as a common system navigation aid available to all aircraft flying in the United States. This was not only attractive economically, but would also eliminate the need for a proposed civil distance measuring equipment that was competing for frequency spectrum space in the same band as TACAN. However, the distractions of the Korean War, the opposition of civilian flying interests, and the then existing hope that TACAN would be a secure system providing navigation service to friendly aircraft, while denying it to unfriendly aircraft, delayed this proposal until 1954.

The Department of Defense proposal that TACAN become the one common navigation system raised a storm of controversy in 1954. This controversy still rages and has produced many wild statements and half-truths concerning TACAN and its rival navigation systems. The intention here is to describe TACAN, not to deal with the various pro and con arguments, but one by-product of the storm is worthy of note. The almost microscopic examination and testing of TACAN over the past two years has resulted in an accelerated shakedown and debugging of the equipment that would hardly have been possible in twice that time under normal circumstances.

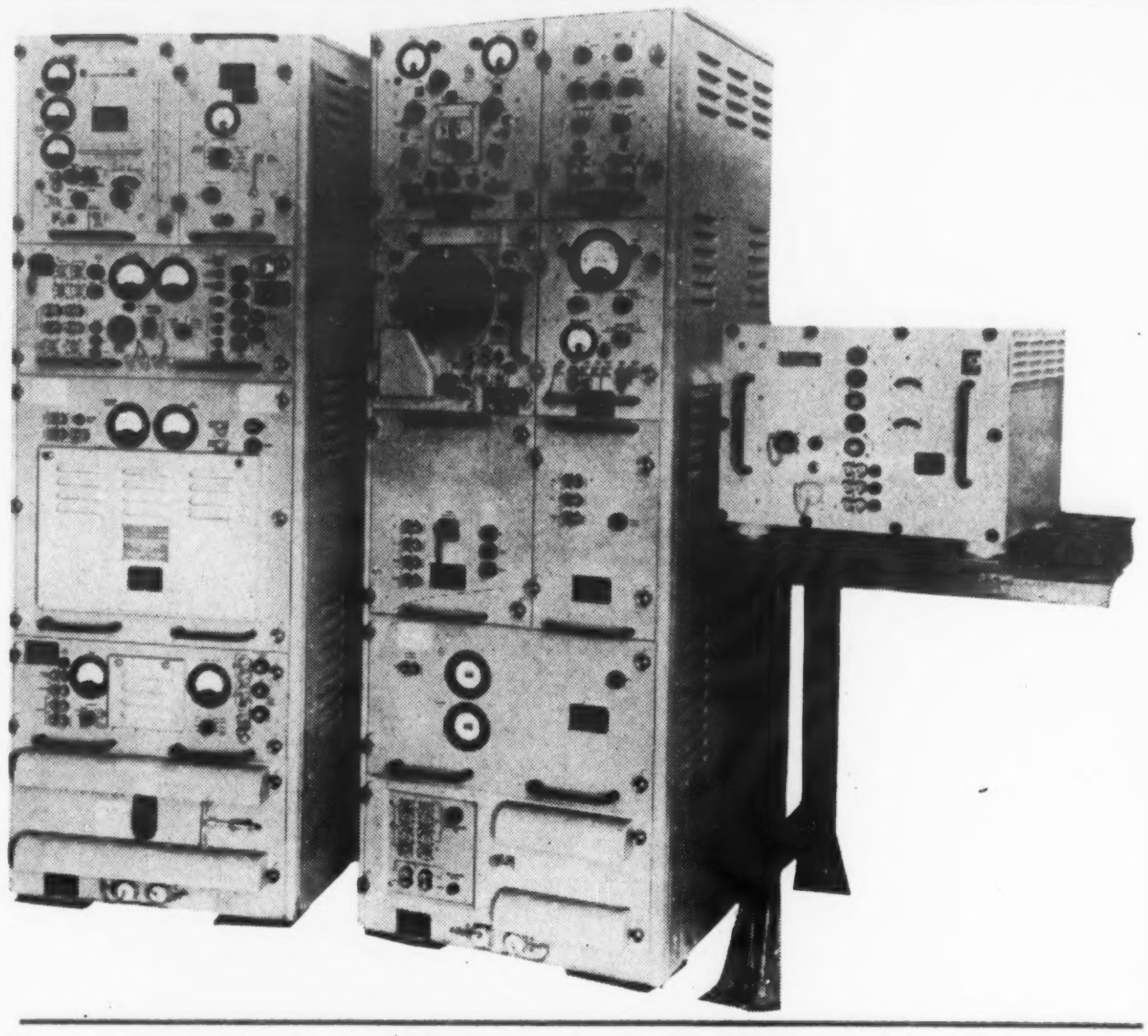
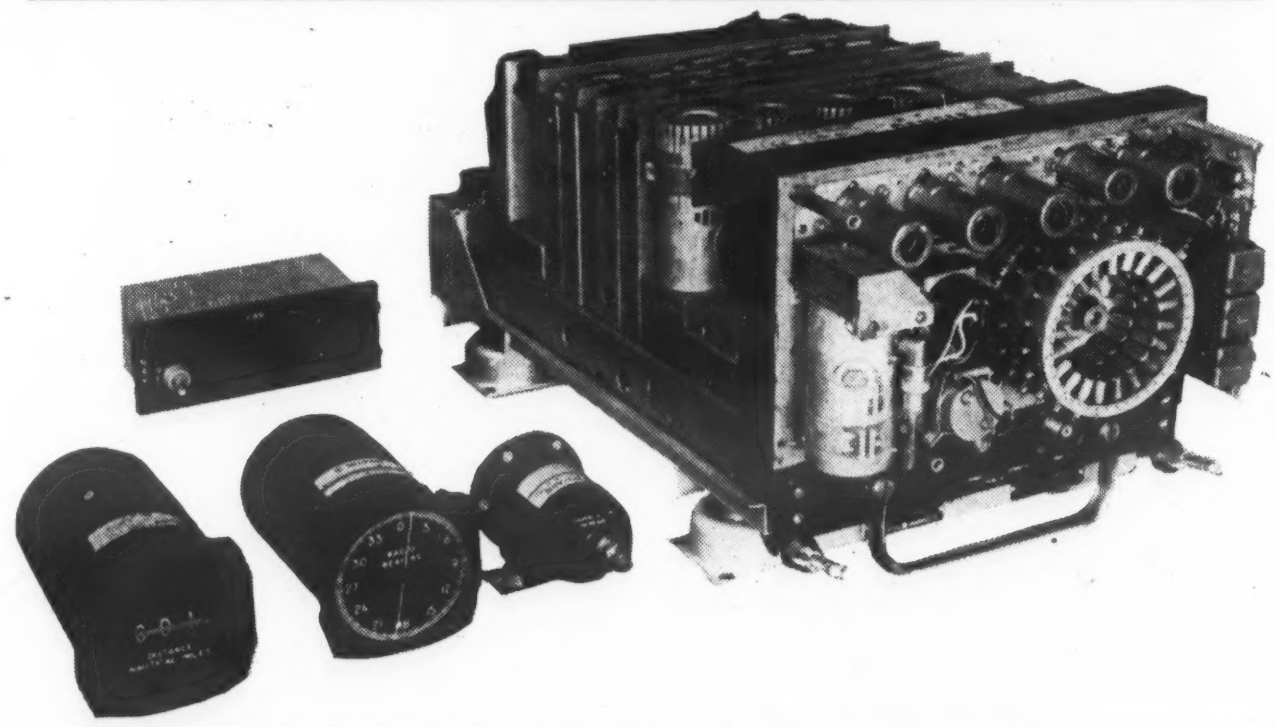


Figure 1. Shown above is the TACAN ground unit, AN/URN-3, complete with test equipment and monitor.

Distance & Bearing Information

The present day TACAN equipment provides Rho (distance) and Theta (bearing) information on 126 channels, each channel providing both. It is also designed to accommodate other functions, such as a communication data link on the same channel. The Rho function is provided by an airborne transmitter transmitting one kilowatt pulses at a random rate of about 30 per second. These pulses are received on the ground where they trigger a pulse transmitter on another frequency. These retransmitted pulses are received back in the aircraft and their delay from the initiating transmission measured. This delay, when corrected for the fixed internal ground beacon delay, is proportional to the distance from aircraft to ground beacon. The airborne circuits recognize only those replies in synchronism with the aircraft's own random interrogation rate which permits many aircraft to use single ground beacon. The limit on number of aircraft per beacon is primarily a function of the average power capability of the beacon and is currently about 100 aircraft per beacon.

Figure 2. The TACAN airborne unit, AN/ARN-21 shown with dust cover removed. A possible set of instruments and a control box for pilot use are also shown.



TACAN Ground Beacon

The TACAN ground beacon, known as the AN/URN-3, uses a constant-duty-cycle principle. An AGC system maintains the output at a certain number of pulses, 2,700 per second, whether the beacon is being interrogated or not. These pulses are randomly spaced when no aircraft are interrogating, except during periods when the beacon is transmitting its identity code.

Each interrogating aircraft synchronizes some of the random pulses with its own transmissions to obtain Rho information. To tolerate interruptions to Rho information from identity transmissions and other causes, the airborne ranging circuits have a ten second memory once they are locked-on a beacon.

The Theta, or bearing, function is provided by amplitude modulating the constant-duty-cycle pulse train. This is done by rotating a reflecting element around an otherwise omnidirectional antenna. Each time the reflecting element passes west, giving a maximum signal to the east, a reference signal is transmitted. The phase

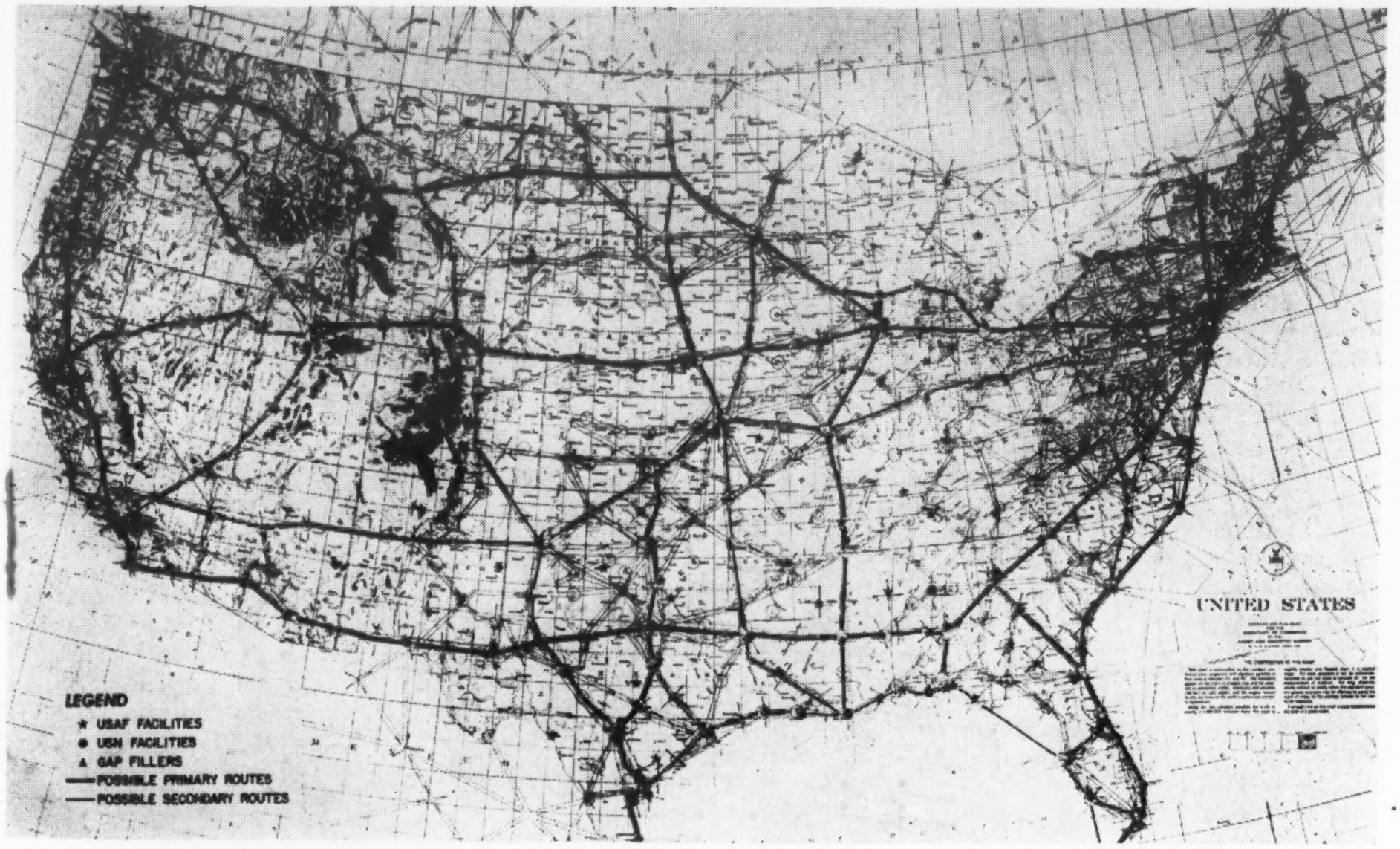
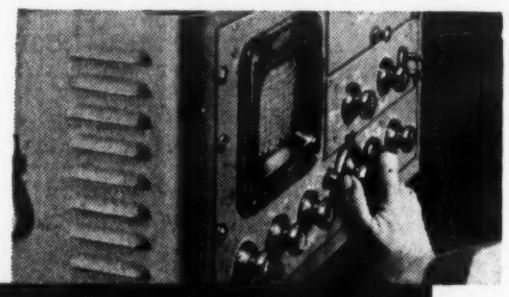


Figure 3. The map pictured above shows a plan for the installation of TACAN stations in the United States.



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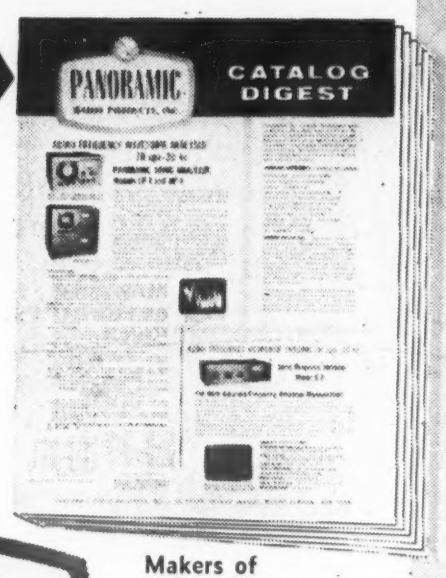

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of the amplitude modulated signal relative to the reference signal therefore varies with the direction of the aircraft from the beacon. The amplitude modulated pulses are converted in the aircraft to sine waves by means of a peak rider and we have a rough measure of bearing.

By using a multilobe, produced by rotating nine equally spaced parasitic elements about the antenna in synchronism with the first element, a 135 cycle sine wave can be superimposed on the original 15 cycle sine wave. Using a phase comparison on this 135 cycle signal gives fine bearing information. The use of this "vernier" gives TACAN its accuracy. With the beacon on a good site, bearing errors can be held to within .20 degrees on over 95% of all measured bearings.

Requirements Pose Problems

The TACAN requirement for 126 channels from air to ground and from ground to air necessitates one megacycle channel spacing to fit the 252 frequencies required into the available 960-1215 megacycle band. This channel spacing posed an adjacent channel selectivity problem of some magnitude. The most recent change in the equipment achieves an adjacent channel rejection figure of 60 db and better. This is achieved with shaped video pulses and trans-

mission filters in the ground equipment, good frequency stability, and a narrow banded IF strip in the airborne unit.

The ground equipment, Figure 1, includes the constant-duty-cycle receiver, a shaped pulse transmitter of about five kilowatt peak power with circuits that generate the reference and identity signals. It also includes special test equipment and a monitor. The same design is used for shipboard and shore installations. Shipboard antennas, however, use three servo systems to maintain the antenna orientation independent of roll, pitch, and ship's heading. The airborne equipment, the AN/ARN-21, Figure 2, includes a receiver with a local oscillator that also forms the exciter for the transmitter. The output of the receiver feeds the bearing and ranging circuits. The latter supplies the video trigger to the transmitter.

These units supply line-of-sight coverage to a range of at least 200 miles and to an altitude of 50,000 feet. Bearing information is not reliable above a vertical angle of 45 degrees. The line-of-sight restriction is the only characteristic limitation of the system.

Implementation of TACAN

The Air Force and Navy believe they have in TACAN an answer to their short distance navigation problem. The system capacity, accuracy, and adaptability to mobile use are adequate for a number of years to come. The air and ground units are being purchased and installed at a planned rate, though not without the problem usually associated with large scale implementation.

A large problem involves the implementation of TACAN ground stations in the United States. Figure 3 shows one plan of station locations. This plan may be described as a minimum acceptable one for the movement of TACAN equipped aircraft within the U. S. Extension of the plan is being delayed until the decision regarding use of TACAN as the Common Navigation System is made.

The President's Air Coordinating Committee and the Air Navigation and Development Board are expected to submit their recommendations regarding adoption of TACAN as the Common Navigation System shortly. This writer believes TACAN should and will be adopted for use by all aircraft, but regardless of this, TACAN is today beginning its service as a useful tool of our airborne Armed Forces at home and overseas.

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Quotes in Review

a survey of major statements made during the past two months

"Your atomic age Navy, as it exists today or is projected into the forseeable future, is characterized by three salient features, viz.:

A. Its ability to employ atomic as well as conventional weapons offensively from platforms readily mobile wherever deep water exists;

B. Its capability to defend itself from attack by any means, utilizing changed tactics and advanced weapons systems, some of which employ nuclear components, and

C. Its increasing utilization of nuclear power for propulsion.

* * *

"The communications requirements for this atomic age Navy are urgent and demanding.

Fast Carrier Task Force and Ship to Ship Communications

"The modern fast carrier task force will employ a multi-ship formation adequately dispersed—or capable of being quickly dispersed—to minimize damage from atomic attack, but with ships close enough together for maneuvering and deployment for offensive air operations and for defense against air, surface and submarine attack. Pickets or scouts will be stationed at considerable distances, airborne early warning aircraft and a combat air patrol of fighters normally will be operated.

"Such a formation must be alert for combat at all times and must be capable of simultaneous offensive and defensive operations with little or no warnings. Ships must be maneuvered, early warning information received, air and submarine defense data exchanged, air offensive and protective fighter operations controlled—all requiring communications, mostly urgent and principally by radio. Prior to detection, the task force must restrict the use of radio.

"To meet these requirements, which increase in difficulty as ships get farther apart, medium and high frequencies often must be utilized in lieu of UHF or VHF. Radio teletype or other means of information and data exchange supplement voice. Where distances are great and receiving conditions bad, resort is made to manually keyed Morse CW—for the signal can be copied by the trained ear of the skilled CW operator when nothing else will get through.

"Developments are proceeding in the fields of tropospheric scatter and single side band techniques to provide an increased capability. Visual signalling—including flag hoist, semaphore, flashing light—is utilized where conditions permit. Developments in high speed, automatic systems are expected to provide a greatly increased capability over the antiquated hand-operated systems which have been in general use for many years.

* * *

"We are now providing and developing equipment and techniques with the peculiar and difficult problems of submarines in mind. For example, the submarine antenna problem is no mean challenge. The space and weight problem approaches that of the aircraft. But we are making progress and have something considerably better than the old 2,000 DC motor generators.

Ship to Air Communications

"Voice transmissions on UHF are employed as the primary means of communications with aircraft in the fast carrier task force, with automatic airborne relays utilized to extend the communication range as required. Single sideband techniques will be employed on medium and high frequencies for communication with the larger type aircraft.

Shore to Ship Communications

"Primarily in order to obviate the requirement that ships answer up and thus possibly disclose their identity and location, it is well known that the Navy delivers much of its traffic to ships by the fox or broadcast method. In order to insure reliable communication, we normally utilize a series of transmitters and frequencies for this purpose, including a VLF, LF, and several high frequencies. All the VLF, and some of the LF and high frequencies, are Boehme or hand-keyed at speeds of about 20 wpm; but many of our LF and HF broadcasts are transmitted by FSK radio teletype. All of our larger ships and many of our smaller ships are now radio-teletypewriter equipped. Since, as indicated earlier, slow speed hand-keyed CW with an experienced receiving operator will get through when nothing else will, the need for a slow speed Morse Fox broadcast may continue for some time. In addition, technical difficulties to date have prevented the reliable utilization of FSK radio teletypewriter techniques on VLF. It is apparent, however, that multiplexing and utilization of radio teletypewriter techniques on the Navy's large investment of powerful VLF transmitters is a development which must continue to be pursued vigorously. In this connection, the Navy is building a new VLF transmitting station in Washington County, Maine, which may exceed even Jim Creek in power output.

Ship to Shore Communications

"In lieu of the medium and high frequency double sideband CW systems now employed for ship to shore traffic, developments are now proceeding toward the use of single sideband radio teletypewriter techniques.

Medium and High Frequency Communications Generally

"In order to provide an increased capability, as well as to assist in alleviating the over-crowding of the frequency spectrum, the Navy recently adopted a policy that all future procurement of medium and high frequency communications equipment must have a single sideband

capability. Of course, for a number of years our medium and high frequency equipment must also be capable of operation on double sideband techniques. The Navy plans to introduce some single sideband equipment in the fleet during 1956.

Point to Point Communications—Automatic Switching

"Along with our sister services, the Navy is now adopting automatic switching at its principal relay centers within the continental U. S. At a later date, it is expected that automatic switching equipment will be installed at some overseas centers.

Ionospheric Scatter

"In collaboration with the other services, the Navy is proceeding to implement its agreed portion of a world-wide FPIS network in order to increase traffic handling capacity as well as to provide an increased capability against interference."

RAdm. H. C. Bruton, USN
Director, Naval Communications
AFCEA Washington Chapter

"The effectiveness of all major weapons and weapons systems has become so completely dependent upon electronics that the value of the major portion of the national defense effort is controlled by the performance of electronic devices. The reliability of most of these electronic devices is marginal, and may prove to be entirely inadequate for many of the complex weapons systems now under development.

". . . the Assistant Secretary of Defense (Applications Engineering) recently initiated an extensive program to improve the reliability of military electronic equipment. This program attacks the reliability problem in many specific areas of design, test, production, procurement and maintenance where it has been determined that reliability is most seriously affected.

* * *

"Unless reliability is defined in a way that can be measured quantitatively during the production and testing phase, we cannot determine whether any action taken to improve reliability is effective. Neither can we determine the relative reliability of two or more similar equipments. Most important of all, we will not be able to specify reliability in procurement contracts in a way which can be legally enforced until we have established definite numbers and factory measurement processes.

* * *

"In establishing methods for specifying and measuring over-all reliability, we must adopt the same positive attitude that was taken when environmental specifications were originated. If we wait for enough data to become available to insure that our methods are perfect, we will seriously delay this important part of our program. We must start now to specify reliability on a basis that reflects the best information available. The accuracy of our methods can be corrected from time to time as we obtain more information relative to correlation between simulated test results and service operational data.

* * *

"A firmly expressed specification for reliability, vigorously enforced by Government inspectors, will probably discourage inexperienced or unqualified contractors from bidding for the design or manufacture of complex electronic items. Perhaps this may be construed by some as constituting discriminatory and unfair procurement practices. Actually, it is probable that most of the

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industry will appreciate having a firm requirement for reliability rather than a vague demand that equipment be reliable without reference to its degree or how it can be measured.

* * *

"I do not know what the group of experts working on this problem will develop as the best way of specifying reliability. There has been a growing tendency to talk in terms of "mean time between failures." This may be the answer, but I do not wish to prejudge the efforts of the group working on this problem. Regardless of how reliability is specified, it must be possible to confirm it by measurement under conditions where the variables can be controlled, and it must represent conditions at least as severe as the average requirements of the operational mission.

"Before any reliability clause could be included in a procurement specification for bidding purposes, it would be necessary to establish its reasonableness by making measurements on pilot quantities of the new equipment produced as a part of the development and initial production contract. This pilot quantity of equipment should be manufactured under conditions representative of full production, utilizing manufacturing drawings and specifications. Enough equipments should be built and tested to prove the feasibility of meeting the reliability requirements under full-scale production. Once the feasibility of meeting the reliability specification has been established in this way, it can be put into subsequent procurement specifications as a firm requirement. It would then be necessary for subsequent contractors to qualify the reliability of his product before it would be acceptable to the Government.

". . . to assure that the essential military demands for equipment are met, there should be more than one producer of new items which are required in large quantities for service use. This would have several advantages: first, it would give competition in quality and reliability; second, it would insure having a source of equipment supply if one contractor fails to produce satisfactorily. Also, in any subsequent order, it would make competition possible on the basis of quality as well as price.

"The quantities and rates of production contracted for initially should be the minimum needed to meet essential service installation requirements. After each contractor has manufactured a sufficient number of sets to give a good indication of their relative reliability, contracts for additional quantities of equipment could be negotiated with these contractors on the basis of quality as well as cost. At this stage, a contractor could be dropped if he had failed to meet the reliability requirement or was otherwise unsatisfactory.

* * *

"The other aspect of our reliability improvement program which I would like to discuss is related to the problem of obtaining sound engineering, thoroughly tested with regard to its ability to meet all requirements of service use—including reliability—before a new equipment or system is committed to quantity production for service use.

* * *

"The Office of the Assistant Secretary of Defense (Applications Engineering) is preparing a directive which will provide uniform policies on approval of electronic items for service use throughout the Department of Defense. It will also require more thorough evaluation of new equipment prior to approval to determine that satisfactory standards of reliability and producibility are met. . . .

"If we can successfully complete, as planned, the important parts of the reliability improvement program which I have outlined to you, we will have a greatly improved basis for reliability in military electronics by the end of 1956.

"To summarize, this will include:

(1) A firm requirement for reliability in our design and procurement specifications, expressed in terms which can be measured accurately in the factory. These specifications will provide, for the first time, standards for accepting or rejecting the product of an electronic equipment manufacturer on the basis of reliabilitv. This should have a very beneficial effect upon reliability by stimulating competition for quality as well as price.

(2) A design specification which will make it mandatory that certain design practices and philosophies, known to be essential to reliability, are included in the development of all new items of electronic equipment.

(3) A uniform and more adequate policy for approval of new electronic items for service use."

J. M. Bridges
Director of Electronics
Office of the Assistant Secretary
of Defense (Applications Engineering)
AFCEA Chicago Chapter

"The Naval ships, aircraft, and Fleet Marine Forces that compose an amphibious attack force of the Fleet constitute one of the most powerful, unique, mobile, flexible and self-sustaining offensive forces in the world. No other nation presently approaches the amphibious capability of the U. S. Navy. We want to be sure to keep it that way.

"Maintaining the Fleet Marine Forces appropriately organized, properly equipped, adequately trained and capable of moving into combat fast, with a heavy and sustained blow, is a task upon which maximum effort is constantly directed.

* * *

"One of our major problems is to keep pace with the rapid development of new weapons, equipment, electronics and the like, adapting those which increase our fighting power without reducing our mobility and flexibility.

"While dispersed, our formations must be controlled, and their movements and actions fully coordinated and perfectly timed. Concentration must be fast and flexible, responsive to battlefield intelligence, and again fully coordinated.

"In meeting these broad requirements, we must have comprehensive development programs which never lose sight of the ultimate goals. We must attain highest efficiency, and cannot overlook any promising direction of research and development. At the same time, since our assault forces must be transportable by helicopter, we must not burden our troops with non-essentials, or lose flexibility by an obsession with gadgets. *Simplicity* is still a military virtue of the highest value.

* * *

"Amphibious operations of the future will place more difficult requirements on radio communications and electronics than any operation in the past, and very few past operations have been satisfactory in this respect.

* * *

(*Continued on page 62*)

As flight systems have become more complex, speeds higher, space and weight-saving more valuable, the increasing rate of technical progress in the aircraft industry has created a serious problem:

Keeping its products up to top level of operational effectiveness—and in the air—has become a major responsibility of the prime contractor.

Martin has been working on that problem for many years; and the result is a new kind of service organization and systems method which now provides for the maintenance of all Martin products—from the company's assembly lines to operational flight lines anywhere in the world—at peak effectiveness and with maximum availability.

It is service on a *systems* basis, and already it's setting a new pace in the industry.

MARTIN

Quotes in Review

"This primary reliance on radio poses many urgent and demanding problems—I would like to have you consider a few of the major ones:

First: Overcrowding of the frequency spectrum. Presently, only a small portion of the frequency spectrum is usable for reliable communications. The Marine Corps has taken a step to move out of this overly used portion of the spectrum from 2 to 100 megacycles by sponsoring the development of radio relay equipment in the 5,000 megacycle range. In addition, the use of the single sideband techniques is being vigorously pursued.

Second: Countermeasures. Any electronic device is subject to countermeasures action and here lies one of the great dangers of having to rely primarily upon radio communication. Much investigation and development is required in this field.

Third: Equipment Maintenance. Maintaining complicated electronic equipment in reliable operating conditions will be one of the prime problems in providing successful communication support for future amphibious operations. Part of the problem may be solved, of course, by making the equipment as reliable and as simple to operate and repair as possible.

And finally: Range Requirements. There are two chief means of increasing the range of radio equipment—increasing the power output of the equipment, and increasing the effectiveness of the antenna radiation. We are still using the same unsatisfactory antenna systems we used in World War II. Portable power supplies have not progressed much further than the antenna systems. Increased emphasis is presently being placed on these two important means of attaining increased range in our portable equipment. Unfortunately, the problem of increased range, azimuth coverage and accuracy is compounded by the helicopter lift limitations which restrict the weight and size of equipment.

"We are making progress toward the goal. Improved communications and electronics equipment such as: radio and radio relay; air surveillance; battlefield surveillance; enemy weapon locators; helicopter navigation systems, and supporting arms control systems are essential to support the amphibious operations of the future. This equipment must have the characteristics of reliability, simplicity and ruggedness, coupled with smallness in size and weight."

Maj. Gen. Edward W. Snedeker, USMC
Assistant Chief of Staff, G-3
Headquarters, Marine Corps
AFCEA Washington Chapter

"For what we mostly need is ideas. Americans already have the necessary spirit of independence and the desire to improve their living conditions through their own efforts and through working together towards common ends. And our fundamentals are sound.

* * *

"I like to think that there is a growing realization of our common interest in business and in maintaining a climate which encourages *private* spending, *private* investment, *private* research, *private* enterprise. This country is too big and its needs too varied to be subject to the will and control of any man or group of men. The smears and appeals to class stratification and class hatred sound pretty hollow, now that the people have found the formula for combining their zeal for freedom and independence with their desire for a fuller life, the formula that bids fair to establish peace, prosperity and progress as the normal human condition."

Walter Williams
Under Secretary of Commerce
Governors' Dinner
New England New Products, New Methods and Patents Exhibit
Boston, Massachusetts

Important New Provisions of the Reserve Forces Act

(*Continued from page* 30)

governing the selection of persons for enlistment in the Ready Reserve who possess critical skills, and for screening of the Ready Reserve for persons who fall in this category. The salient provisions of these Executive Orders are: the young man

1. must enlist in a unit of the Ready Reserve for eight years;
2. must perform an initial period of active duty training for not less than 3 months or more than 6 months, and
3. must satisfactorily perform all training prescribed for balance of eight year obligation—however, under certain conditions may be excused from this training.

Persons so enlisted will be in a draft-deferred status as long as service is performed satisfactorily. They are exempted from further military obligation except in time of war or declaration of a national emergency.

The Act directs a system of continuous screening of units and members of the Ready Reserve. By this process, a Reservist is retained in the Ready Reserve or transferred to the Standby Reserve. Advantages of this screening are:

1. In event of mobilization, personnel and units in the Ready Reserve will be immediately available and fully qualified for active duty. These units will not contain men who have critical jobs in industry.

2. Men with critical skills will not be kept in the Ready Reserve unless those skills are actually being used to meet a military requirement.

3. Combat veterans are less likely to be ordered to active duty.

4. Men will be transferred to the Standby Reserve in cases of extreme personal or community hardship. They will not be ordered to active duty if they are more important to the Nation in their civilian jobs than in their military duty.

This screening process can work in reverse. If a man transfers from a critical skill job to one that is not critical, the screening process would result in his being made available in a military capacity.

The employer will obviously benefit by whole-hearted cooperation with both the Six Months Plan and the Critical Skills Program.

1. He will be assured of a better satisfied, more stable labor force.
2. He will enjoy better public relations.
3. He will develop more responsible employees.
4. He will be able to forecast more accurately the fulfilment of his personnel requirements.

In the final analysis, every citizen holds the key to ultimate success of the program. Combat skill is a perishable commodity which must be constantly renewed. The Reserve Forces Act of 1955 represents a challenging movement towards fulfillment of our goal; it prescribes the methods whereby our combined efforts may be used to insure our Nation's strength in Reserve.

Foreword

Since World War II, two factors have pointed up the limitations of high frequency radio as a suitable means of communications for the Air Force which places great dependence on it to fulfill its requirements. The first is the significant and continuing increase in the speed, range and firepower of our weapons. The second factor, deriving from the first, is the concept of global war involving an orientation of air forces for conflict over and through the Arctic and subarctic regions.

High frequency, with all its vagaries —particularly when the auroral zone is transmitted—fails to meet Air Force standards of reliability. "New Horizon for VHF" describes the actions taken by the Air Force to adapt to its requirements the technique of communication by Forward Propagation by Ionospheric Scatter.

When this project was initiated, it was based only on the empirical results of experimental operation by the National Bureau of Standards, without complete theoretical support and confirmation of its practicability. That this technique has proved successful during more than two years of operation by the Air Force is a tribute to the scientists and engineers who saw in FPIS a means to overcome the limitations of high frequency propagation.

Brig. Gen. Alvin L. Pachynski, USAF
Deputy Director of Communications-Electronics, USAF

SCATTER—NEW HORIZON FOR VHF

by Major Conrad J. Welti, USAF
Directorate of Communications-Electronics
Headquarters, U. S. Air Force

Another military-industry project which will ultimately benefit the entire communications field

SOME 30 YEARS AGO, PROGRESS IN communication by radio waves took a great stride forward with the discovery of skywave propagation. However, since that time there have been few major discoveries in radio propagation. Fifteen years ago it was radar. About the same time, microwave and VHF began to assume a role of importance, opening up new horizons for utilization of the frequency spectrum.

Now we find ourselves in the midst of a new and dynamic development involving the exploitation of frequencies above what was once considered the maximum usable frequency (MUF) for communication with terminals beyond the radio horizon. This is done by a technique employing the scattering of radio waves in the atmosphere.

Some Fundamentals of the Earth's Atmosphere

It is not the objective of this article to present a technical description of Forward Propagation by Ionospheric Scatter (FPIS); however, for the benefit of those who are unfamiliar with this mode of communication, the following fundamental information will be helpful.

Until as late as the last century, little was known of the earth's atmosphere. For a long time it was thought to be a homogeneous mass having an exponential density-altitude relationship. Scientific investigations, spurred by Marconi's first transatlantic communication in 1901, later identified and located distinct atmospheric regions by their physical and electrical characteristics. These are the Troposphere, Tropopause, Stratosphere, and Ionosphere, in upward order.

The ionosphere is known to consist of at least four layers, D, E, F1, and F2. Electron density governs radio wave reflection, and increases to new maxima from layer to layer with increasing height. Also, the higher the density of layer, the higher frequency it will reflect. Electron density then determines the MUF for skyway propagation.

Prior to the introduction of FPIS, it was believed that communication of frequencies above the MUF was practical only over line-of-sight distances. By the rule of electron density, higher frequencies were not reflected. In fact, however, there were weak reflections (or scattering) in the lower ionosphere which had gone undetected in the collective absence of high transmitter power, sensitive receivers, and highly directional antennas.

A long distance test receiving terminal on Terceira Island, Azores, looking toward Newfoundland.

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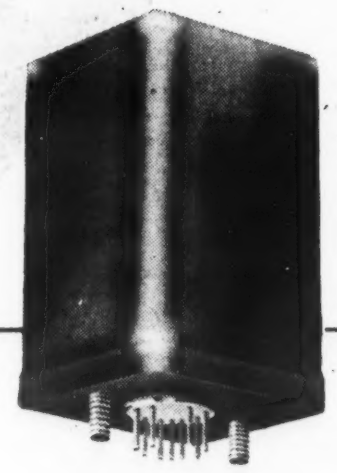

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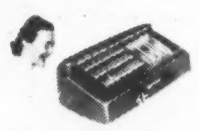

Nurses' Call

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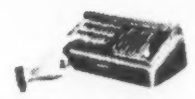

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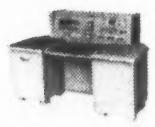

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The advent of frequency-modulated VHF and television broadcasting on a large scale focused attention on anamolies of VHF propagation that had long been overlooked. The possibility of useful communication over long distances was first considered seriously in 1950 after applying the Booker-Gorden theory of tropospheric scattering to the E region of the ionosphere. Dire need for the increased communication potential that forward scatter could offer, plus the possibilities for improved reliability, resulted in prompt support of further research effort in this field.

Implementation of the first ionospheric scatter circuit between Cedar Rapids, Iowa and Sterling, Virginia, in 1951, is a noteworthy milestone in the progress of radio communications. Successful performance of this circuit is well documented in National Bureau of Standards reports and other articles.

The Author

Major Welti enlisted in the Air Force in 1936 and was commissioned in India during World War II. He spent eight years with AACS in the U. S. and in the Pacific, and, after a brief tour with TAC, he attended a "Training With Industry" course with the New Jersey Telephone Co. He was then assigned to the AF Directorate of Communications-Electronics. In his present position with C-E, he has worked closely with the Bureau of Standards and Page Communications Engineers, Inc. in completing the BITTER SWEET *project and in other scatter development work.*

Project Bitter Sweet

Within four months after the Cedar Rapids—Sterling circuit was demonstrated to the military services, the Air Force elected to pattern an operational system after it. The route from Thule Air Force Base, Greenland to Limestone, Maine was chosen not only for operational reasons, but to take advantage of the inherent characteristics of FPIS, namely, immunity to sudden ionospheric disturbances and relative independence of signal strength from capricious gymnastics of the MUF. Considering the very limited knowledge of FPIS, project BITTER SWEET began cautiously with the installation of a one-way test circuit from Goose Bay, Labrador, to Sondrestrom, Greenland, and soon developed into a complete 4-channel duplex radio teletype system from Limestone to Thule, with relays at Goose Bay and Sondrestrom.

Though project BITTER SWEET was completed in November 1953, it has

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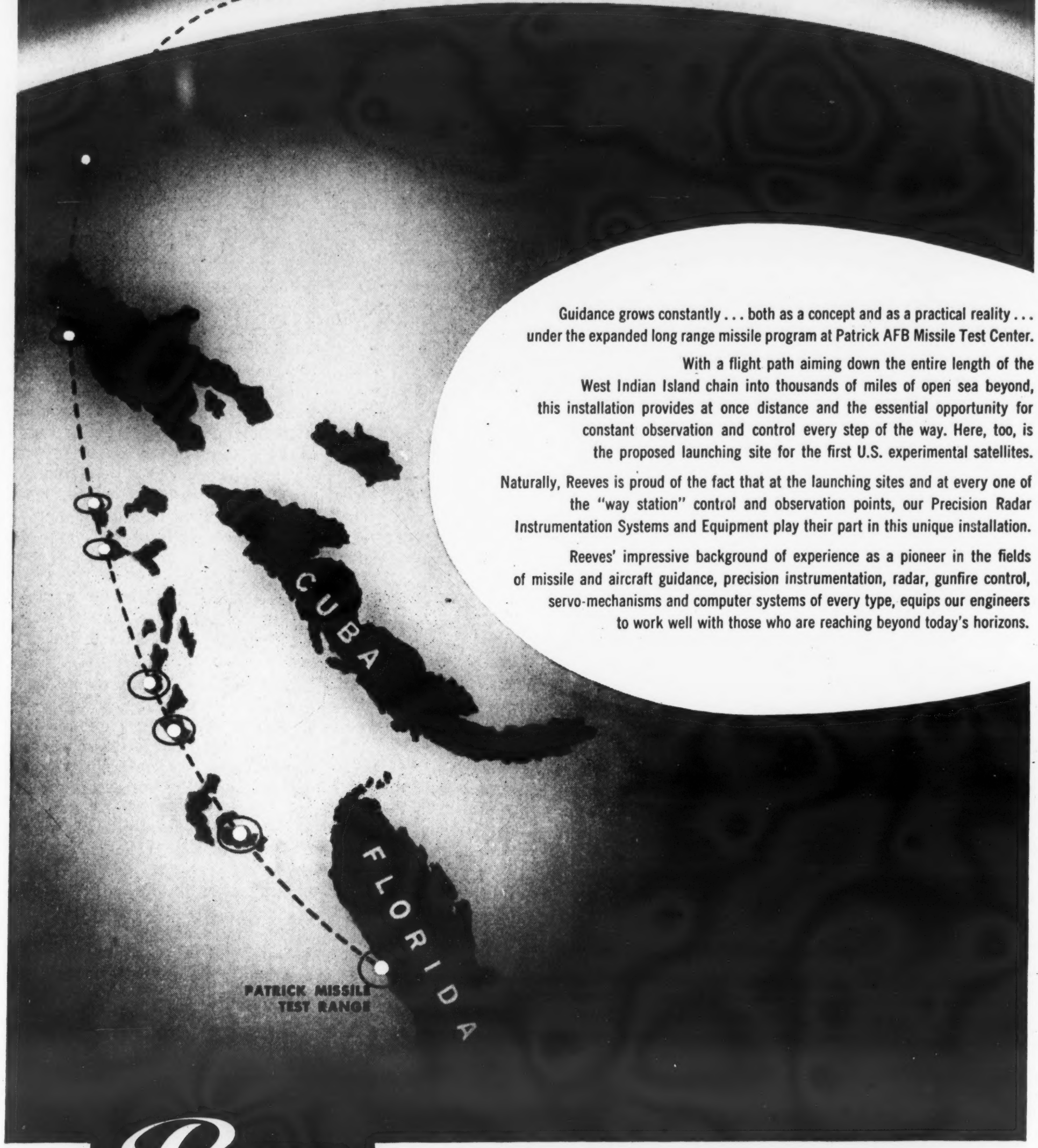

Guidance grows constantly . . . both as a concept and as a practical reality . . . under the expanded long range missile program at Patrick AFB Missile Test Center.

With a flight path aiming down the entire length of the West Indian Island chain into thousands of miles of open sea beyond, this installation provides at once distance and the essential opportunity for constant observation and control every step of the way. Here, too, is the proposed launching site for the first U.S. experimental satellites.

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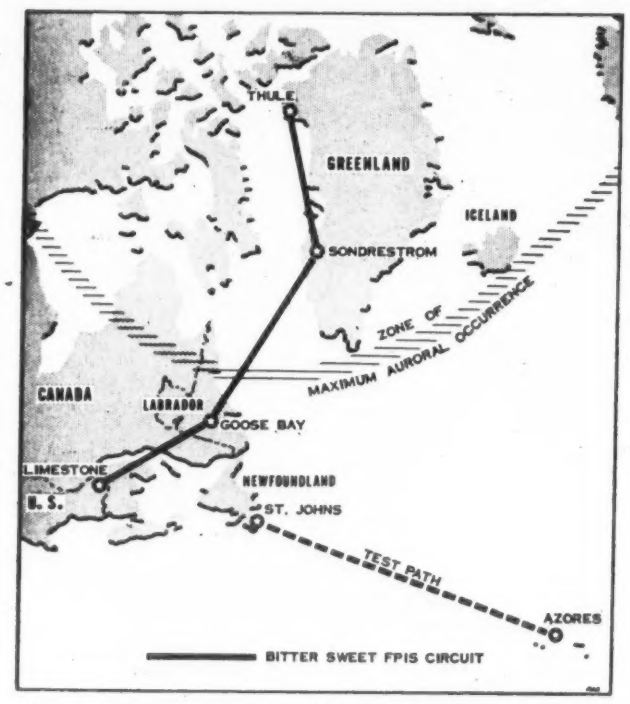
undergone many modifications since, to keep pace with channel requirements and new equipment developments. Every seasoned communicator is familiar with the rule of thumb that says channel requirements for a given system always exceed those available. BITTER SWEET was no exception, and so it became obsolete immediately. Firm requirements were expressed for a system having 8 teletype channels, with an optional arrangement of 4 teletype channels plus one voice channel. The National Bureau of Standards and Page Communications Engineers, Inc., under whose joint efforts BITTER SWEET had been built, devised and tested a system for accomplishing the desired channel expansion. This scheme, acknowledged as a quick, temporary means of obtaining additional channels, was justified and implemented on the basis of early results. Concurrently, other modulation and multiplex techniques were placed under development.

Bitter Sweet Confirmed Propagation Theories

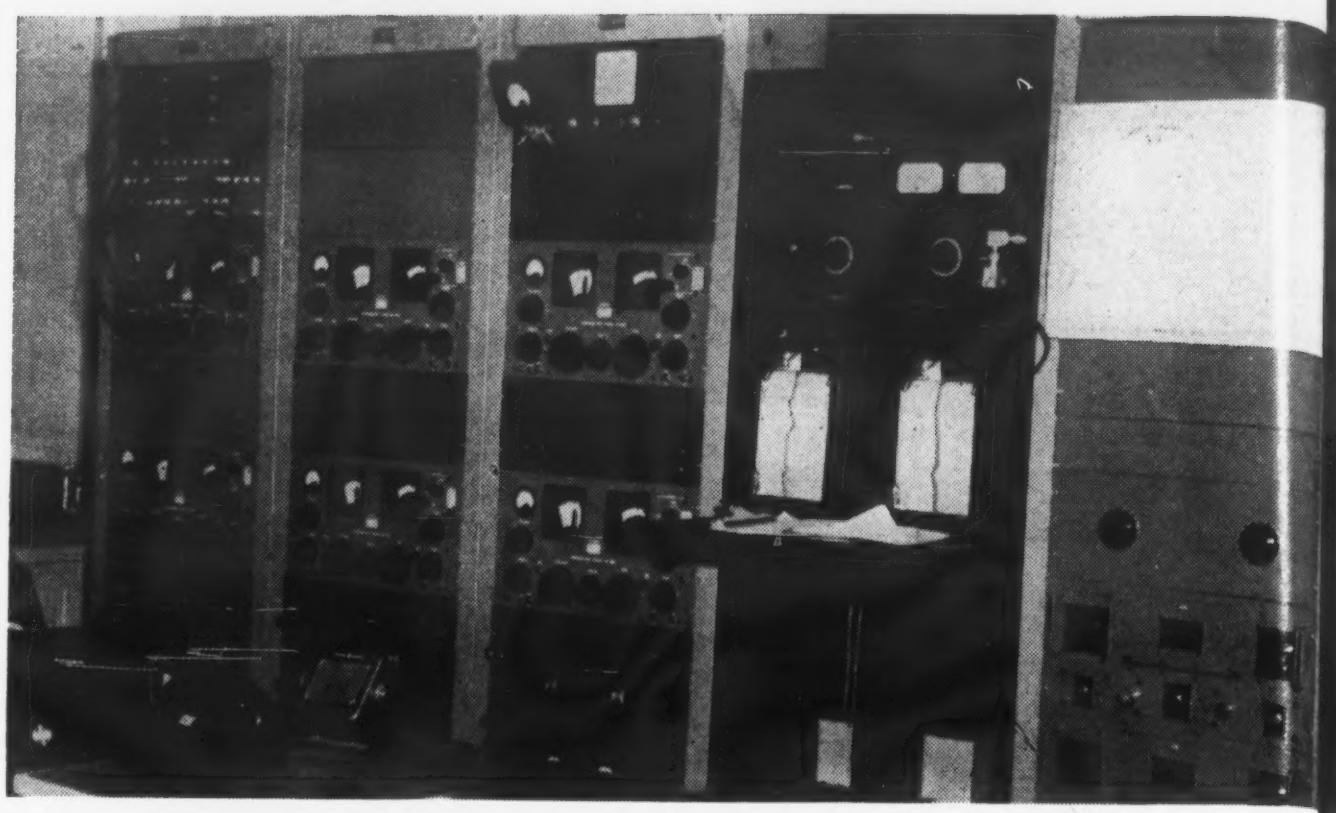
A year's accumulation of performance data on project BITTER SWEET generally confirmed earlier opinions on propagation reliability and revealed other statistical curiosities. Propagation outage on the link



The Project BITTER SWEET Forward Propagation by Ionospheric Scatter circuit.

between Goose Bay, Labrador, and Limestone, Maine, was the greatest of the system, 5%. The central and northern links averaged only about .5%, a tenfold difference. This difference is attributed to two factors; (1) the relatively short distance between Limestone and Goose Bay (570 mi.), and (2) the weaker influence of the auroral zone at this midpath latitude.

The most suitable path lengths are considered to be between 700 and



The BITTER SWEET FPIS receiving terminal equipment at Goose Bay.

1,200 miles. Beyond this upper limit of range the received signal intensities decrease with increasing distance as a consequence of earth curvature and height of scattering stratum. As the path length is decreased below the lower limit of range stated above, the scattering efficiency decreases as a consequence of the scattering angle. Contrary to HF behavior, ionospheric scatter signals are perceptively improved by auroral activity, thus circuits within or near the aural zone perform better than those farther away.

Over-all system reliability as distinguished from propagational reliability was determined to be 91.4%. Of the remaining 8.6% outage, only 2% was due to propagation. The greatest offender was equipment outage, which included scheduled maintenance. This accounted for 4.4%, or about half of the total outage. Complete backup equipment was not included in the original BITTER SWEET plan because it was not desired to invest heavily in an unproven communication technique which would in any case employ improvised equipment.

Development Campaign

Project BITTER SWEET touched off an active development campaign which had dual objectives: (1) to design and build FPIS equipment sufficiently advanced to preclude becoming obsolete soon after installation, and (2) to rehabilitate the existing system to provide the support of standby equipment and incorporate as many equipment refinements as were currently available.

The AN/FRT-6, a 40 kw transmitter used at all Northeast Air Command FPIS terminals, was built for HF service; consequently, it had to be modified to operate on the frequencies between 30 and 40 mcs employed on these circuits. While performance in this band was generally satisfactory, the AN/FRT-6 had some features unnecessary for FPIS service, and lacked other desirable features. Even with the frequency modification, efficiency dropped rapidly as the upper part of the band was reached. To obtain the channel capacity and degree of reliability now in demand by using agencies, experience gained by the Air Force indicates 40 kw to be the minimum desirable power.

Increasing frequency over four or five mcs, or path length even modestly beyond about 1,200 miles, will require a substantial increase in power to maintain circuit integrity. It is not unlikely that some circuits will require as much as 400 kw into the antenna. With 30 to 60 mc generally accepted as the optimum band for ionospheric scatter, and the use of higher power foreseen, it is obvious that new, specially designed transmitters are needed.

Design and construction of transmitter prototypes was started early by Collins Radio Co., Continental Electronics, and Rixon Electronics, Inc., for Department of Defense projects under various contracts. This only marked the beginning of a concerted effort to produce suitable FPIS equipment. Concurrently, the Lincoln Laboratory designed a receiver —FSK exciter unit to replace the conventional receivers and converters. This is know as the Lincoln FSK-I system. Subsequent improve-

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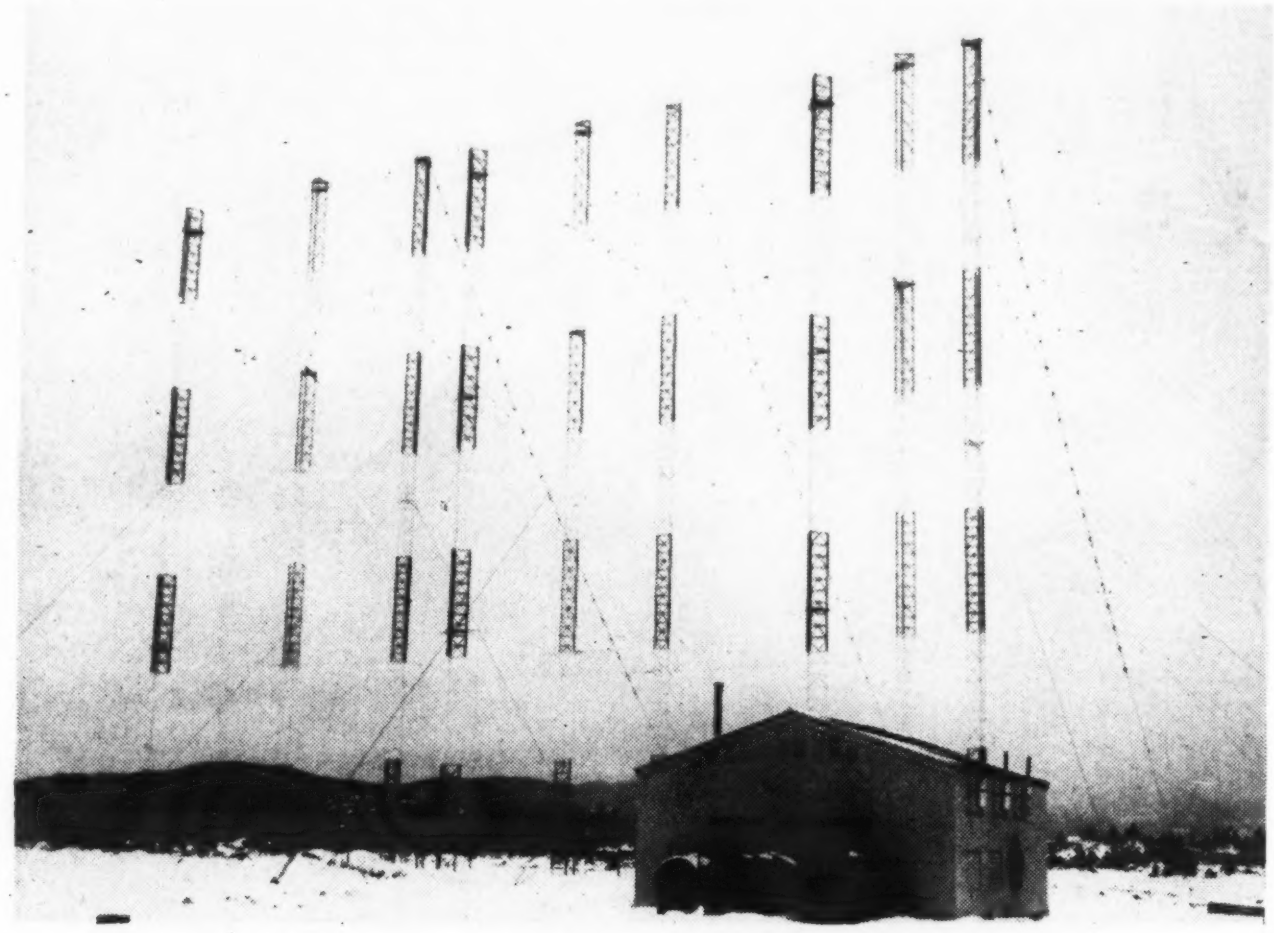
ments brought about the FSK-II model.

In the field of multiplexing, new components and techniques offered a potential improvement over the four channel AN/FGC-5 set used in the original BITTER SWEET system. Collins Radio and Rixon Electronics each engineered new multiplex systems designed to fit the peculiar characteristics of ionospheric scatter, as well as provide up to 16 teletype channels. The practical upper limit of transmitter power has not yet been reached, but transmitter powers of the order of 300 kw are envisaged. Any further significant increase in system efficiency, therefore, would be most economically obtained by other means. *On the basis of experience with the* BITTER SWEET *system, greater emphasis is being placed on equipment reliability, parallel installations, and standby equipment wired for automatic changeover.*



The FPIS corner reflector antenna at Goose Bay. In the foreground is the receiver power building. The striped effect of the antennas is caused by light color portions against a gray sky.

Antenna Improvement

One of the most profitable areas of development has been antennas. Considerable progress has already been made here, and there is reason to believe that the field has not yet been fully exploited. Prior to constructing the BITTER SWEET system, suitability tests were conducted over the Goose Bay to Sondrestrom path on corner reflector, half-rhombic, and full rhombic antennas—all vertically polarized.

These early experiments paid good dividends in terms of year-round performance. Vertical polarization was eliminated in part because of the adverse influence of changing snow levels on the radiation pattern. Though both rhombic and corner reflector (horizontally polarized) antennas were used on project BITTER SWEET, the corner reflector has become widely accepted because of its smaller size and superior radiation directivity characteristics, particularly with respect to reduced side and back lobes.

The passing of the BITTER SWEET rhombic should be referred to with some respect. The double-curtain stacked rhombic was an antenna of no mean proportions by any standard. Its length ranged up to 2,500 feet for as many as 40 wavelengths per leg. Main lobe directional and gain characteristics were excellent. Merits of the Yagi antenna have not been overlooked in the search for an ideal ionospheric scatter antenna. Yagis were used for extended path propagation tests between Newfoundland and the Azores, and at present a large Yagi is teamed with a corner reflector at Goose Bay for comparison in diversity reception.

Recent studies indicate that the best antenna for average ionospheric scatter paths is not necessarily best for all installations. Extremely low radiation angles and large antenna heights are necessary for very long paths. When conventional antennas are employed there is an undesirable formation of multiple vertical lobes among which the power is distributed. Since only a portion of these lobes are useful, only a fraction of the radiated power is effective. It is believed that further research will yield an antenna especially suited for very long path service which is capable of up to 9 db improvement over the corner reflector. The extention of multi-channel FPIS service to paths of the order of 1400 miles in length will require the combined benefits of increased transmitter power and improvements in antenna design.

Problems Under Study

The BITTER SWEET system was completed near the minimum of the sunspot cycle. At that time, there was little or no interference by F2-layer propagation on the frequencies in use. As F2-layer ionization increased with solar activity, so did reports of interference. The new problems they created are under study and can be resolved in one of three ways: (1) establish clear channel frequency authorizations; (2) move ionosphere scatter frequencies up sufficiently to render them less subject to long distance interference, and (3) make dual frequency allocations, using upper frequencies only while F2-layer reflections would deleteriously affect the use of lower frequencies. The discussion supporting a choice of one of these methods would occupy a volume by itself and is beyond the scope of this article. The subject is only mentioned to point out the influence of changing sunspot activity on FPIS frequency planning and equipment design.

For a given power, use of higher frequencies than originally used, and therefore above the MUF for most of the time, will alleviate the interference problem but will be accompanied by a degradation of the signal to noise ratio with a consequent reduction of channel capacity. Much consideration has been given recently to the use of two frequencies, alternating their use to conform as required with diurnal and seasonal variations of the MUF. Economy in this practice, with respect to antennas, would be facilitated by the development of a single antenna that would operate efficiently on both frequencies.

Additional Distance Tests

Early investigations of ionospheric scattering included some distance-dependence measurements by means of a portable receiving station moved along the transmission path. Data obtained indicated that the maximum

(*Continued on page* 71, *col.* 2)

The Shortage of Scientists and Engineers and Its Impact on Our Air Technical Programs

(*Continued from page* 34)

they are considering as careers, by inviting them to visit laboratories where they might later work, and by talking with them and answering their questions. It is important to note the potential benefit of this enlightened policy to the recruiting efforts of industry and Government.

The ways of helping students financially need little explanation here. What I do want to point out is this: although the amount of money expended for scholarships is slowly rising, the percentage of total student fees paid by scholarships and fellowships dropped from 7% in 1949 to 5% in 1955. There is obviously room for improvement.

Teacher Shortage

I should like to point out that increasing the number of high school students in science will only make worse a critical shortage of teachers for these students. The Commission on Human Resources and Advanced Training states that the shortage of mathematics and science teachers is already more acute than that of engineers and scientists. Consequently, we must take additional responsibility for increasing their number and improving their lot. What we can do for them is similar in nature to what we can do for the students: motivate them to go into and stay in teaching.

To a well-qualified physicist, mathematician, engineer, chemist, or any other specialist, the "call" to teach must be exceptionally strong to overcome his perfectly natural desire to enjoy the material things his ability could earn for him outside of scatter-teaching. To make this call stronger, we in industry and Government can take such steps as the *establishment of free summer seminars and workshops in the technical fields to provide the teacher with a means of keeping abreast of his field; the establishment of summer scholarships; the creation of summer employment for teachers in order to increase the relatively small income most of them receive; the use of qualified teachers as part-time consultants, and the establishment of awards of various kinds for contributions to the teaching profession—and these awards might well be as tangible as the automobile awarded to the successful football coach!*

These would all be "fringe" benefits. The basic problem is teachers' salaries. And we can do something about them. If leaders in industry and Government recognize that they are of such significance within the community as to participate actively in the Community Chest, for example, they should also feel concerned about schools and salaries. As citizens, it is our responsibility to take the lead in community efforts to raise teachers' salaries. The additional taxes this raise will call for will be amply repaid in the improved quality of our teachers and our students. If our schools and colleges are to attract and keep the first-rate men needed to produce the continuing supply of first-rate technical graduates so essential to our survival, then the gap between the material rewards in teaching and in industry must be narrowed. As citizens, we can and must do our part to make sure that it is narrowed.

Potential Threat

I have discussed several very serious problems here. Without exaggeration, their solution may be the key to our national survival. Air Force Secretary Quarles has said, "The critical shortage of engineers and scientists in America is potentially a greater threat to our Nation than any weapons known to be in the arsenals of aggressor nations." Fortunately, we can do something about this threat in the ways I have outlined above. We have the resources in men, money, and materials. With the proper cooperation between industry, Government and schools, we can develop the engineers and scientists needed for our expanding civilian economy and the defense effort.

New Horizon for VHF

(*Continued from page* 68)

useful range was about 1,200 miles, with terminals located on flat terrain. If a means of using slightly longer paths could be found, the value of ionospheric scatter would be greatly increased, as several potential overwater circuits somewhat exceed the 1,200 mile limit.

It was decided to make additional distance tests using sites with more favorable physical characteristics. A 1,411 mile path from St. Johns, Newfoundland, to Terceira Island in the Azores was chosen. With the advantages of good overwater Fresnel zones and high site elevations, signals were recorded continuously for one year. Recorded signal levels confirmed earlier predictions that to sustain a given communication capacity, a modest increase in path length beyond 1,200 miles must be accompanied by a corresponding increase in the transmitter power, elevated sites with ideal horizons and refined antenna systems.

Spectrum Space Problem

While ionospheric scatter has many inherent advantages, it is no panacea for communications ailments. Various factors such as cost, critical siting requirements, and inherent distance limitations tend to restrict use of this technique.

Unfavorable topography has, in at least one instance, prevented installation of an ionospheric scatter circuit. *Frequencies, however, are by far the greatest impediment to extensive use of forward scatter communication.* The already overcrowded spectrum cannot accommodate a new band allocation without displacing older, firmly established services. The extent to which this is eventually accomplished will no doubt be a measure of the merits of this new mode of communication.

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Some Problems in Procurement

by Commander Gerald L. Griffin, SC, USN
Office of Naval Material

IN READING THE PAPERS DURING THE LAST THREE months, you undoubtedly are aware that the fragile bark of military procurement has been weathering some pretty stormy seas. First, the military were accused of flagrantly violating the authority of the Armed Services Procurement Act with respect to the use of negotiation. Later, there came a report to the effect that the profits and executive compensations in the aircraft industry were far too high and that somehow the Air Force and Navy were to blame. On top of these, the headlines chronicled the allegation that the general procurement practices of the entire Department of Defense certainly left a lot to be desired.

These things are cited because they serve to focus attention on the fact that the major part of the defense dollar goes for procurement, and when you couple this with the fact that the Department of Defense spends the greatest share of the national budget, you realize what a tremendous undertaking military procurement is.

Congress, the public and industry are vitally concerned with how well the Armed Services are doing in this tremendous field, and, naturally, there are going to be areas in which they are not doing as well as they would like to do. To further complicate an already complex picture, remember that the manufacturing capacity of the United States is 50% greater than at the beginning of the Korean War and this capacity will soon be 100% greater than at the end of World War II. These figures are cited not for their intrinsic significance, which is considerable, but rather to indicate that you can expect more companies to be seeking defense business in the future, and that some companies which may have enjoyed a certain amount of security with regard to special segments of defense production may find eager competitors in some of these fields.

One cannot help but feel that these eventualities will give rise to additional problems which must be solved by those responsible for military procurement. Add to this the fact there are certain segments of industry which are chronically unhappy with military procurement policies and you begin to understand why a lot of contracting officers long for the happy day when they can forget their troubles in such garden spots as Adak or Kwajalein!

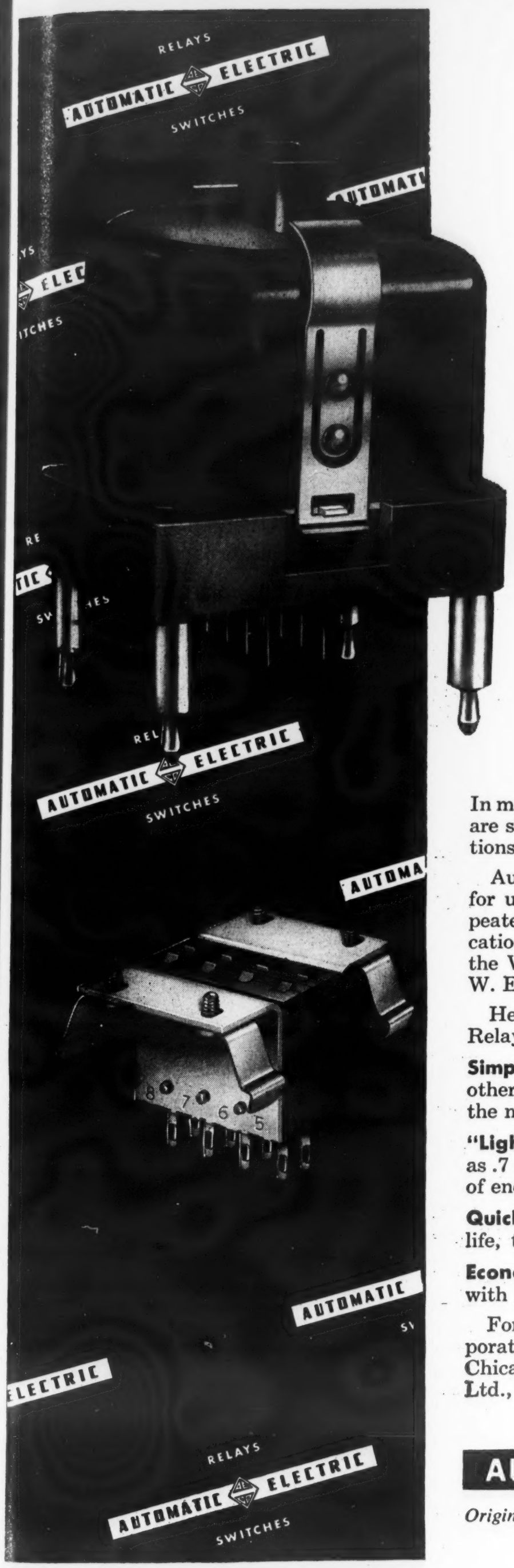
"Differences" in Procurement Policies

If there is one single problem which is heard about most consistently from Congress and from industry, it is the so-called "differences" between the procurement policies and practices of the Army, Navy and Air Force. To some of us, this complaint on the part of industry is a source of constant wonder. What is hard to understand is the fact that the American Businessman, world famous for his independence, initiative and enterprise, should insist that all of the Armed Services must perform their procurement functions in the same way. This is all the more amazing when you consider that the Navy, which is the smallest of the Armed Forces, is larger than any American corporation, and we have seen the trend in large corporations to decentralization by divisions and the granting of almost complete autonomy to those divisions. However, the basic objection to the criticism of the differences between the Services is not directed at the criticism itself but, rather, at the fact that it tends to obscure the similarity in the Services' policies and the constant progress which is being made in the Armed Services Procurement Regulation.

Here, a few words on ASPR are appropriate, since the clear understanding of this regulation is a must for any contractor who is doing a substantial amount of business with one of the units of the Department of Defense. Procurement in the Armed Forces is conducted on a generally decentralized basis—that is, the Army procures through its Technical Services, the Navy through the Bureaus and its field purchasing organization, and the Air Force through the Air Materiel Command and the various Materiel Areas. Each one of these units spends

The Author

Commander Griffin was commissioned an Ensign in 1942. During World War II, he served in the Asiatic-Pacific area and has three battle stars. Before coming to the Office of Naval Material, where he is serving as Special Assistant to the Director of the Procurement Division, he was with the Purchase Division Office of the Yards and Docks Supply Office at Port Hueneme, California.



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a considerable amount of money, and each unit has a set of problems which differ to a small or large degree from the problems of the other units.

To provide uniformity and consistency of policy and procedure where they are essential or desirable is the function of ASPR. Since military procurement must serve a wide variety of missions and requirements, you can appreciate that to draft a policy, which will be a good one for the Department of Defense without doing violence to one or a number of these individual units, and which will be equitable in so far as industry is concerned, is no easy task. *The noteworthy thing about ASPR is that it has been able to reconcile into a working policy document so many varying shades of opinion, and especially those opinions from different sides of the table.*

Industry has always spoken with a strong voice con-

A harried procurement officer dreamed up this cartoon during the Korean conflict. While times have changed and timely performance is no longer the major problem, our author feels there has been little change in the hurdles.

cerning the proposed inclusions in ASPR. This is done through the various associations and by expressions from individual companies. The industry viewpoint receives careful consideration, and as much of it as possible is reflected in procurement policy without compromising the paramount duty of the Government to protect the public interest.

Constantly Changing Document

ASPR is a dynamic document which is constantly changing and expanding to keep pace with a dynamic world. There are still many areas of procurement policy not covered, but the number of areas which have been covered is remarkable. Some segments of industry advocate that ASPR should be the sole procurement regulation and that the supplementary regulations of the individual Services should be abolished. This is what exponents of the opposite school of thought refer to as the "Wendell Wilkie" or "one-book" approach. Suffice it to say, here, that the problem is receiving continuous and serious consideration.

Military procurement is a different beast from general industrial procurement and the thing that makes it different gives rise to some of the problems which perplex industry. The striking difference lies in the public policy considerations associated with military procurement. *Among these considerations are: the necessity to insure that the small businesses in this country receive their fair share of the defense dollar, the providing of assistance to areas of substantial unemployment or to areas which have been visited by some disaster, and there is the obligation on the part of Government contracting units to enforce contractually the national policy against discrimination in employment because of race, creed or national origin.* These problems probably should be classified as annoyances to some segments of industry rather than as real problems, but their existence requires that they be mentioned. If it is remembered that these are things which the Congress and the President feel are in the national interest and if the national interest is considered paramount to self-interest, these problems recede into their proper perspective.

The public policy requires that military contracts be priced fairly and effectively. As you probably know, the bulk of military dollars is in negotiated contracts, so that a great deal of study and judgment on the part of defense contracting officials goes into the ultimate pricing of an item. If the military are to discharge their obligation to the public, they must be as effective as possible in determining that a price is just and reasonable. In general, the contracting officer must also assure himself that the price is one which will be fair to the contractor, since he does not serve his country well by beating a price down to the point of no return.

On the industry side of the table, there is an obligation to furnish cost and price information upon which an intelligent decision can be made. In the long run, a stiff-necked take-it-or-leave-it attitude on the part of industry does not serve our country well. The contracting officer does not expect a gift of the stockholders' money in the form of unrealistic prices, but, rather, that the contract will be made at a price which is right for both sides.

Pricing and Payment Problems

This problem of pricing becomes especially delicate when you consider that the preponderance of military dollars is tied up in incentive or redeterminable type contracts. A recent action on the part of the Department of Defense has caused a certain amount of comment in industry and perhaps a short discussion of this action here will shed some light on the problem which you have not heretofore been able to perceive.

In July 1955, the Navy issued to its contracting officers a procurement directive which said, in effect, that in redeterminable or incentive type contracts payments would be limited to 105% of the costs incurred under such contracts, and that the determination of costs would require invoices to be certified by the contractor. This directive was greeted by industry with something less than enthusiasm,, and the Defense viewpoint may be enlightening.

For sometime prior to July, the Navy had been studying the amounts of payments made under these types of contracts and the financial statements of many of the contractors who held these contracts. It was found that there were large amounts—many millions of dollars—in over-

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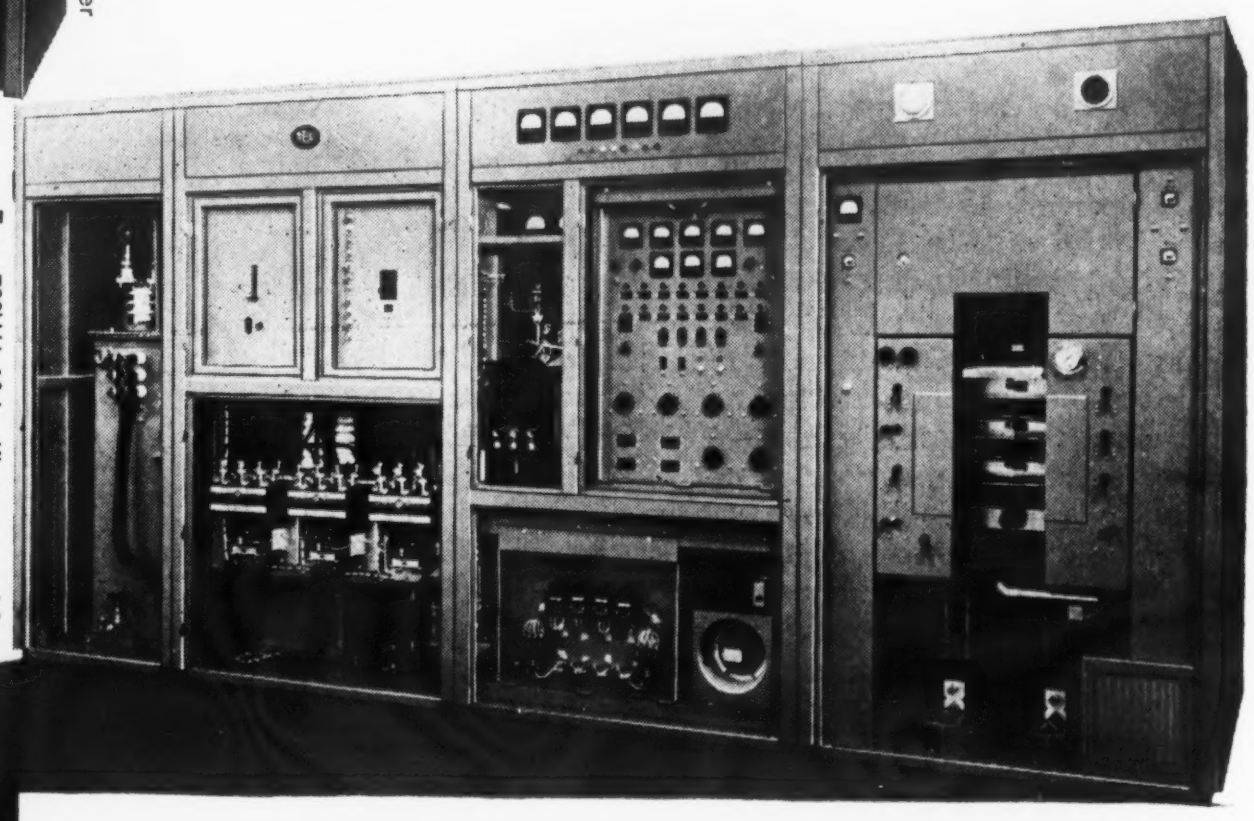

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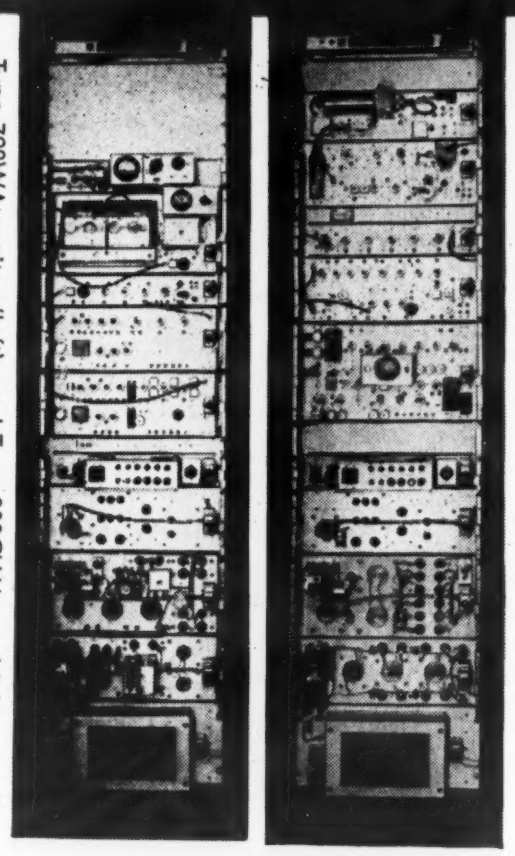

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payments to contractors, based upon the original billing price set out in the contract. First, it was found that in some cases these overpayments had been in the hands of contractors for quite some time, and in some cases it was found that contractors had invested these overpayments in Government bonds.

As businessmen, if you will put yourselves in the shoes of the military, you will agree that this was a situation which could not, and should not, be tolerated. In the first place, it meant that defense funds were tied up and were not working for the Armed Forces. In these days of close budgeting in the military, just as in your business, the Armed Forces simply cannot afford to have idle funds. Moreover, the Navy did not feel that it should be providing either free sources of working capital or of investment return.

Directive Brings Industry Objections

To return to the directive itself, it was later picked up as Department of Defense policy for all of the Armed Forces. However, industry voiced certain strong objections, and not without just cause. The two principal objections were these: First, that the limitation on payments to 105% on costs incurred did not realistically allow for the amount of target profit figured in the contract since these profits generally do not run as low as 5%. Second, industry pointed out that the requirement to certify invoices worked a hardship since the cost and accounting systems of most contractors did not lend themselves to furnishing figures on an individual invoice basis, but, rather, that figures were accumulated in some regular periodic manner, e.g., monthly or quarterly.

To accommodate these views, the Department of Defense directive was revised as follows: First, payments will be based upon the costs incurred for delivered articles, and the limitation on payments is equal to the costs incurred plus the target profit; second, certification as to costs incurred may be made by the contractor on a quarterly basis keyed to the company's fiscal year. Third, for work in process, the provisions of the progress payments clause apply, that is, payments may be made for up to 75% of the costs of work in process.

"Proprietary" Information

Perhaps one of the most complicated issues presently to be resolved concerns the obtaining of technical data and what might be termed "proprietary" information from military contractors and the subsequent use of that data by the Armed Forces. Industry contends that under our present system they cannot protect themselves from the promiscuous disclosure of their manufacturing know-how or trade secrets not susceptible to protection under the patent or copyright laws. Industry has also complained that they have not been compensated for their disclosure of trade secrets when such disclosure is necessary for military reasons. On the other hand, it must be recognized that the public policy imposes an obligation to acquire technical data in instances where the Armed Forces have paid the research and developmental costs.

At this very moment, there is a revised section of ASPR practically ready for adoption and which is considered to be the best solution available for this complicated subject. It is the result of extensive industry coordination and many internal compromises within the Department of Defense. While a great many industry arguments have been accommodated, others have been rejected. However, it is felt that the new regulation is a long stride in the direction of equity for both sides.

The scope of competition and the equalization of opportunity under our system of free enterprise has been a serious problem for our jurists and law makers for many years, so it is not unusual that this same problem should rear its head in military procurement. Right at the moment the Armed Forces are wrestling with this problem: how do you, and how should you, equalize the competitive opportunity between the contractor who has previously been furnished a certain amount of Government facilities and tooling and the contractor who does not enjoy this benefit and must include depreciation of his privately-owned facilities and tooling in his price. Presumably, the former enjoys a competitive advantage. On the other hand, the furnishing of facilities may have been a matter of military necessity and may have required the utmost cooperation of the former contractor. The answer to this one is not easy. Whatever solution is reached as a matter of Defense policy, there are going to be some unhappy companies.

Industry and the Armed Forces are constantly faced with the problem of putting into production new military items on which the specification for product development may not be complete, in order to satisfy operational demands. This necessity often gives rise to unhappiness on the part of contractors over the number of changes to the contract which are issued. The decision to go ahead is not made recklessly, but, rather, so that the most modern equipment can be delivered to our field forces in the shortest possible time.

Procurement is Concern of All

Military weapons today depend so much upon the very latest scientific and technological achievements that we must start with advanced concepts and then accept the necessary changes and modifications as information and production progresses. Indeed, if we are to maintain the lead over our enemies, there is no alternative. *Industry has a right to demand that these changes be handled expeditiously and definitively, and the improvement of these procedures is a matter of continuous concern to all of the Armed Forces.*

If you have read this far, you or your company must have a fairly close interest in military procurement, and it is important to you to know what the official views of the Armed Forces are regarding not only the problems mentioned above, but also many others. Moreover, you have probably wondered if the state of military procurement can be as bad as the headlines mentioned in the first paragraph make it out to be. Generally, the allegations are much more glamorous than the rejoinders and consequently very little of the latter ever gets printed. For that reason, you would be interested in the testimony given by the principal procurement officials of the Armed Forces before several Congressional committees since January. This testimony not only gives the Department's rebuttal to the criticisms leveled at military procurement, but also sets out official thinking on a number of related procurement subjects.

Since this thinking has a direct effect upon the contracts which will be made between the Armed Forces and their contractors, there is no better way of keeping informed than by reading the printed reports issued by these Congressional committees. Even if you don't get much out of the report, your understanding of his problems the next time that you are in discussion with a contracting officer may well be a happy advantage for you both.

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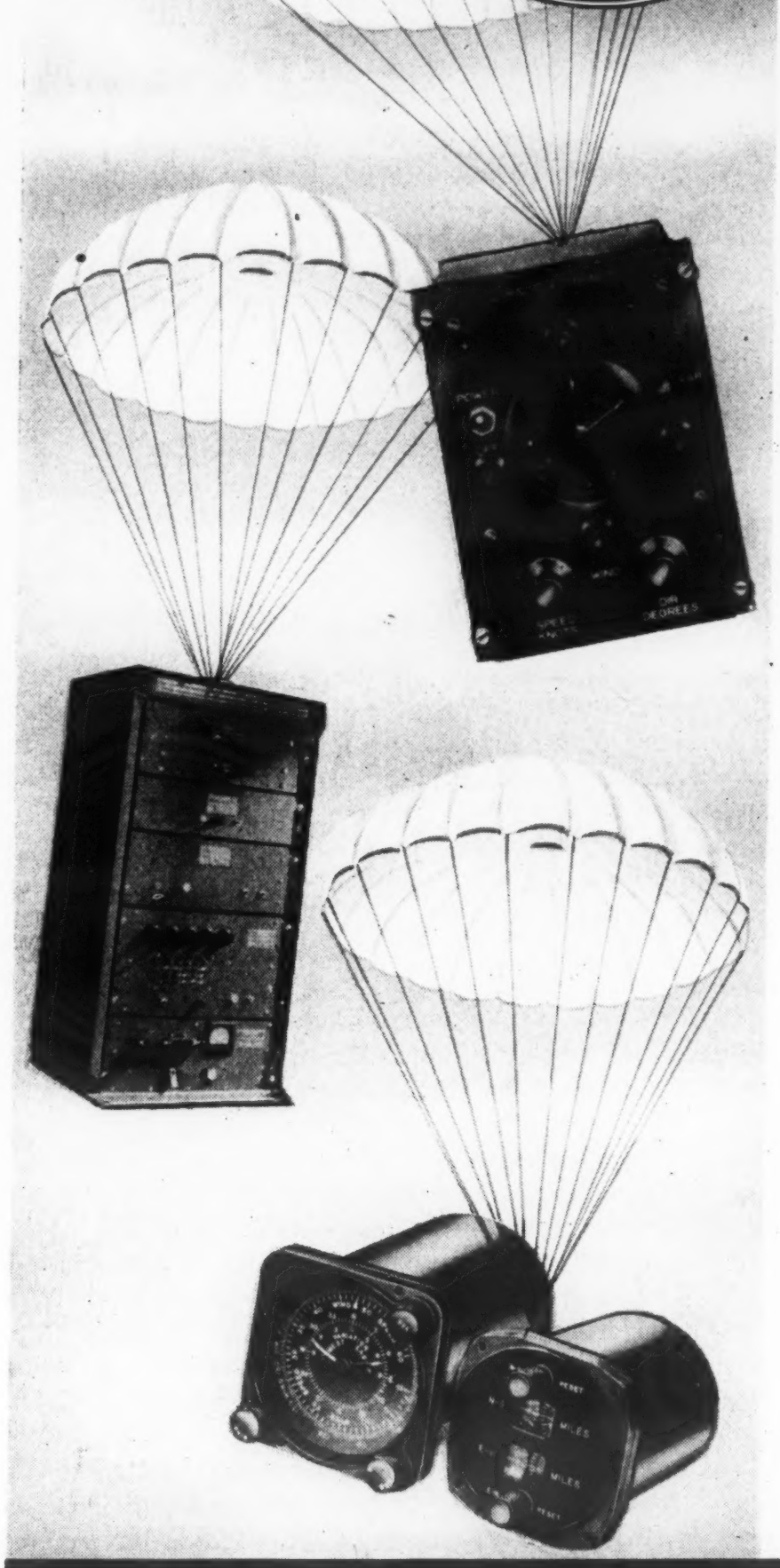

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by Captain Hugh C. Oppenheimer, SigC
Chief, Television Branch
Army Pictorial Service Division
Office of the Chief Signal Officer

Military Television

a progress report

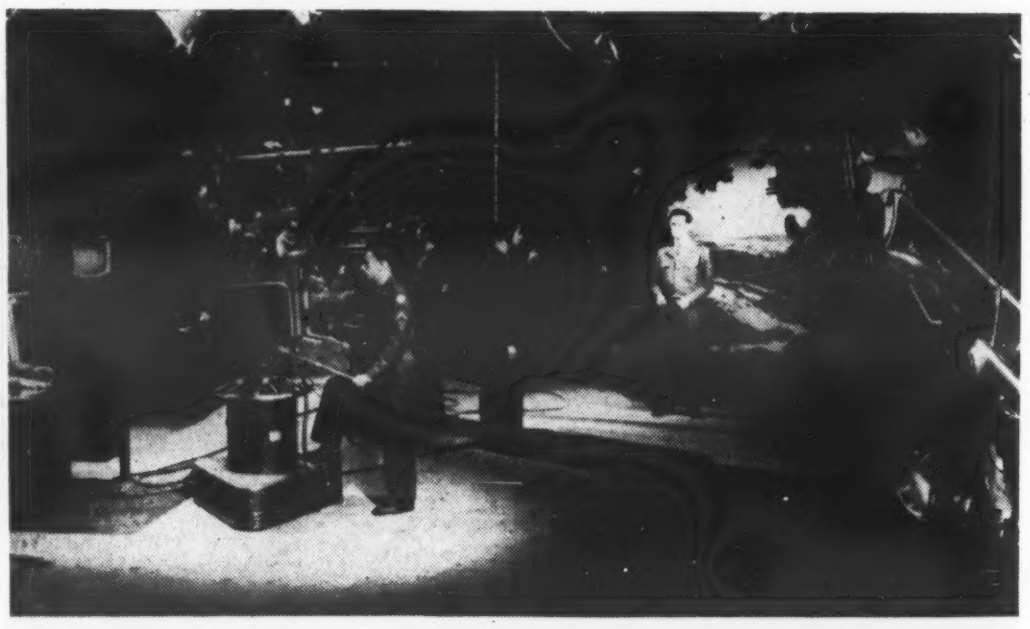
MILITARY TELEVISION IS NOT A NEW CONCEPT. Underlying the development of all military communications has been the desire to obtain the most complete picture possible. The progress of military communications down through the centuries has provided a partial answer. In the future of television may lie the complete answer, *the ability to see immediately and visually control the battle situation.*

In 1934, early in the history of practical television, serious consideration was given to its military application. However, during its early years, only sporadic attempts were made to use it as a military tool, and these were somewhat thwarted by television's limited technological advancement.

After World War II, with the impetus provided by television's entertainment value, rapid strides were made in its technical development. These in turn opened up its military potential.

Television's immediacy, its combination of sight and sound, its ability to transmit one picture or a combination of many pictures from one location to another or to many locations, promised many military uses. The development of some of these, such as technical and industrial applications, morale and special service uses and TV's application as a film production means are adaptions or refinements of commercial uses.

A kinescope production in rehearsal on the main television stage of the Army Pictorial Center, Long Island City, New York.



New Applications Found Daily

Daily, more and more applications are being found for television as a technical or industrial aid. Wherever factors of human safety or comfort, inaccessibility or multiplicity of control are a problem, there is a potential use of television as a solution. This area has received a great deal of consideration by the manufacturers of TV equipment and as a result many systems with component accessories have been developed to do specialized jobs. Fortunately, this equipment can be readily adapted to meet most military requirements. Examples of Army usage in this area have been in demolition activities, missile development and guard work.

A program for establishing a series of television stations in remote locations has been initiated and is being given considerable attention by the Office of Armed Forces Information and Education. These stations, located in areas where no commercial television is available, are low power output so as to confine the signal to the local military installation.

Programming consists of films and kinescopes ob-

tained by OAFI&E of the popular commercial television programs, supplemented by such items as weather reports, news and other activities of local interest. Stations are already installed or are being installed in the Azores, Asmara, Panama, Alaska, the Philippines and Okinawa.

Army Use of Kinescope Techniques

Use of television as a film production means has achieved considerable success in the Army.

The film of a live television presentation recorded from the face of a special type TV picture tube is known as a kinescope. There is nothing revolutionary about this process except in the advantage the Army is taking of it. In commercial practice, the kinescope is something of a by-product of the live presentation, used primarily to extend programming or to circumvent the time differential between the East and West Coasts. However, the Army has developed kinescoping, not as a by-product, but specially, as a supplementary film production means.

Its advantages are flexibility, control, speed and low cost. In a normal film production, the picture is shot scene by scene with motion picture camera movement during actual shooting limited. After all the scenes are shot, much time and expense goes into editing them together.

Television lends itself to being shot in one continuous sequence without any stops. This is possible because the director and cameraman can monitor everything that is happening as it is happening. Thus, cameras are free to move and constant control is maintained over the action at all times. The end product is one continuous film that requires little or no time-consuming and expensive editing.

Originally, the difficulty in obtaining high quality film was a serious limitation to this use of TV. A great deal of effort has been devoted to this problem by the Army Pictorial Center, Long Island City, New York. Here, they have systematically analyzed the entire recording cycle, from production, lighting, TV equipment and film to processing, developing new techniques and making improvements. As a result, the Army can now obtain kinescopes that compare favorably in quality with film produced by standard motion picture cameras.

Training & Combat Medium

Beyond the military adaptions of commercial applications, there are two areas of major military interest that have received special attention by the Army. These are the use of television as a training medium and as an aid to the combat commander.

In developing these areas it was felt that, initially, it would be more practical and economical to use general nature type of equipment to define areas of best military application and then concentrate money and time on research and development projects in areas showing the most promise.

The first positive step in developing the training and combat uses of television was the procurement by the Signal Corps of a specially designed mobile television system in 1951. This unit, dubbed the Signal Corps Mobile Television System (SCMTVS) was developed by the Signal Corps Engineering Laboratories, Fort Monmouth, New Jersey, and the Radio Corporation of America. The unit, with the mission of exploring and evaluating areas of application of television to military operations and stimulating thinking in the use of television, was assigned to the Army Pictorial Center (Signal Corps Pictorial Center) in November 1951.

The SCMTVS was a mobile, self-contained and self-powered television system consisting of three field cameras and an iconoscope chain for displaying films. It was mounted in four 31-foot vans.

During the first part of 1952 this equipment was put through a series of "shakedown" operations. These operations led to some changes and modifications. Chief among these was the conversion of the vans to tractor-trailors. This was accomplished in late 1952. At about the same time an airborne television system operating out of a liaison-type plane (L-20 DeHaviland) was added and a fifth van containing air-ground receivers and kinescope facilities was procured.

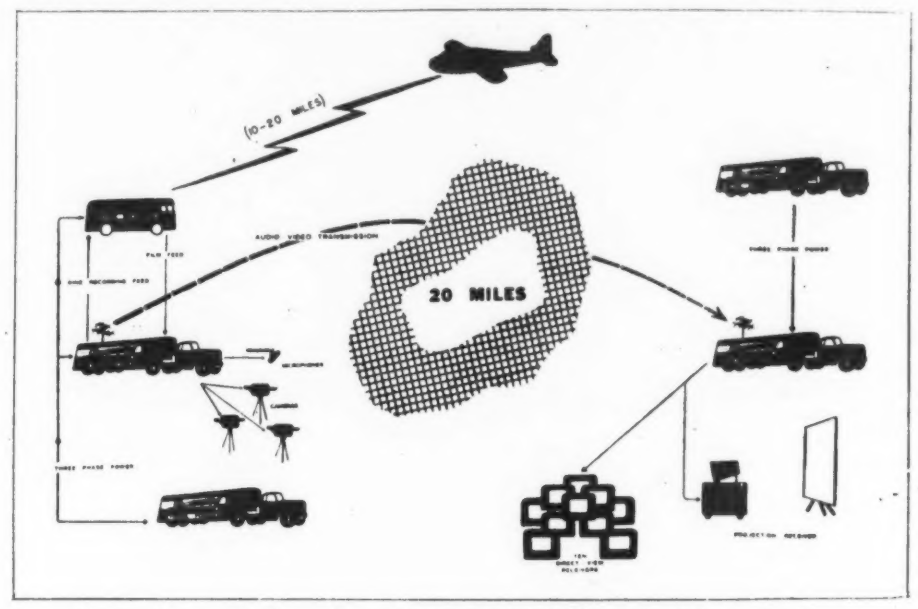
With these changes and additions, the Signal Corps Mobile Television System was launched on a series of exploratory exercises beginning in February 1953. It was to form the focal point and impetus for the development of television in the Army.

Possibilities as Training Medium

During 1953, the Mobile Unit conducted exercises at eleven different military posts. These initial operations showed many promising possibilities for using TV as a training medium. They were:

(1) Conserve or gain maximum utilization of facilities, equipment, training aids and instructor personnel.

(2) Present material where the immediacy requirements precluded utilization of any other method.



Flow chart of the Signal Corps Mobile Television System.

(3) Give identical or best instruction to a large or geographically scattered group.

(4) Reduce or increase the relative size of an object for practical purposes of presentation.

(5) Bring a distant or inaccessible object before a group. Some preliminary evaluation had been done in the training field by other agencies.

However, one of the major requirements indicated was the need for more specific information on the training use and effectiveness of the television medium. Therefore, in October 1953, a research project on this subject was initiated. The project was closely tailored to answer specific Army training needs.

The operational aspects of the study were conducted by the SCMTVS in coordination with The Southeastern Signal School, Fort Gordon, Georgia. The research evaluation was done by the Human Resources Research Office, George Washington University, Washington, D. C. The study was divided into two phases.

The first phase called for a comparison between television and regular instruction under matched conditions utilizing subject matters found in the first eight weeks of Army Basic Training. Underlying this phase was the de-

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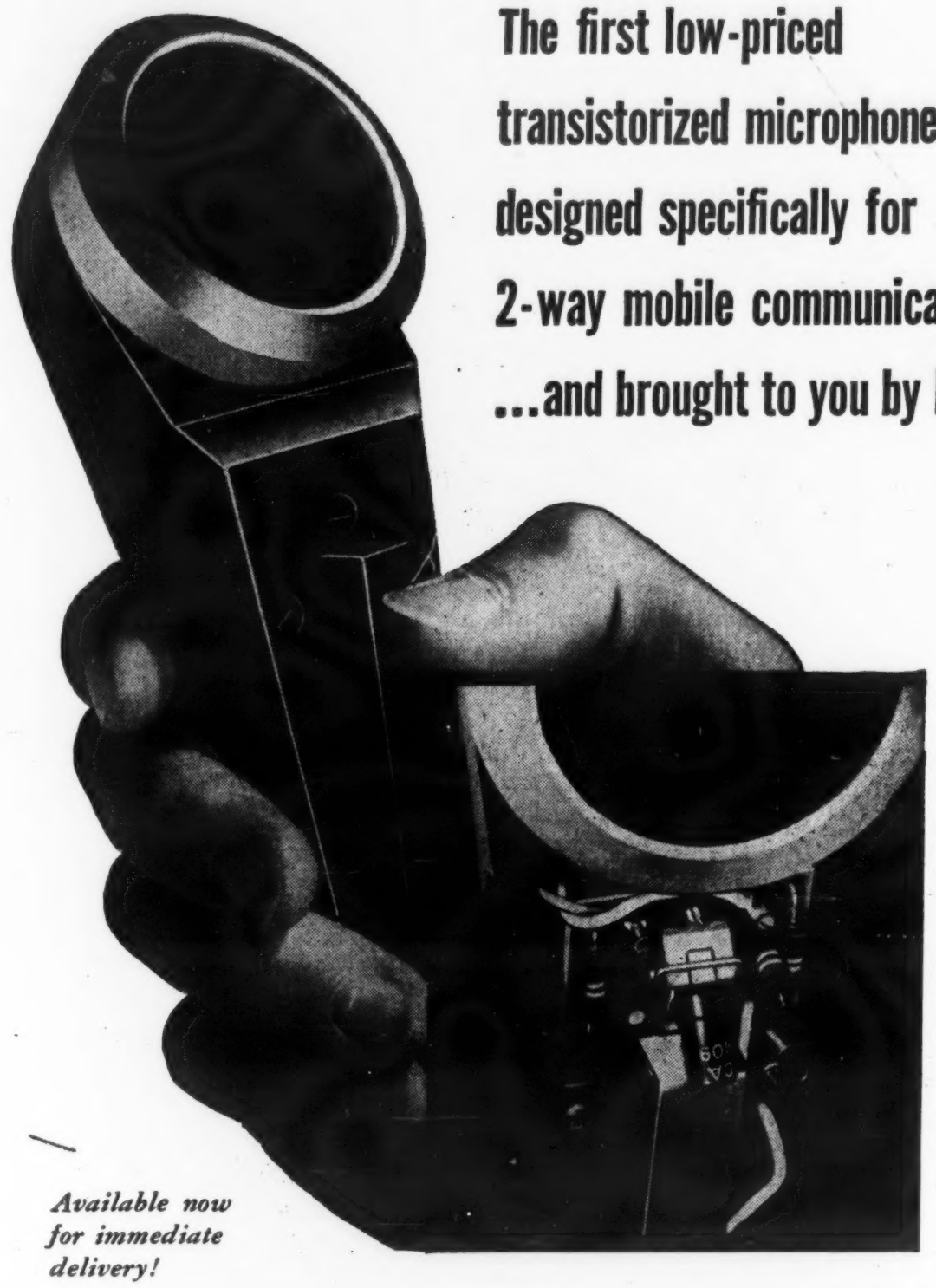

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sire to obtain information on television teaching effectiveness as related to two contemplated applications, (1) the use of television for mass training during emergency situations, and (2) the use of television in the routine, everyday training activities of various Army schools and installations.

TV and Regular Instruction Compared

Throughout this and the subsequent phase, considerable effort was made to insure that the results would be reliable and all possible steps were taken to eliminate any extraneous factors that might tend to invalidate the study. The trainees were matched throughout according to aptitude. The same instructors were used for both TV and regular instruction. For this first "comparative" phase, the television-presented instruction was given with no effort made to insert any production values or special "gimmicks."

Comparison between television and regular instruction under these matched conditions showed that television-presented instruction was:

(1) Generally more effective than regular instruction.
(2) Particularly effective for lower aptitude individuals. Results were compared between the upper and lower 50 per cent of the students divided according to their aptitude. While with the upper 50 per cent there were significant differences in the teaching effectiveness of live or TV-presented instruction, the degree of difference in the lower 50 per cent was, in certain types of instruction, more markedly in favor of television.
(3) Remembered at least as well as regular instruction by trainees of all aptitude levels, and even better than regular instruction by those with low aptitude.

These conclusions were reached after a three months study involving over 12,000 trainees at Fort Gordon. The courses taught involved a range of training material from simple rote learning to performance tasks. Using a variety of training tasks made it possible to determine later the effectiveness of television instruction for different types of training material.

Television "Turned Loose"

The second part of the study had two major objectives: (1) to see if television could be used to decrease training time, without loss of teaching effectiveness, and (2) to extend television training methods from basic to technical subjects.

Secondary objectives were: (1) to develop further criteria for the application of television in training, and (2) to evaluate specialized equipment, such as cueing devices.

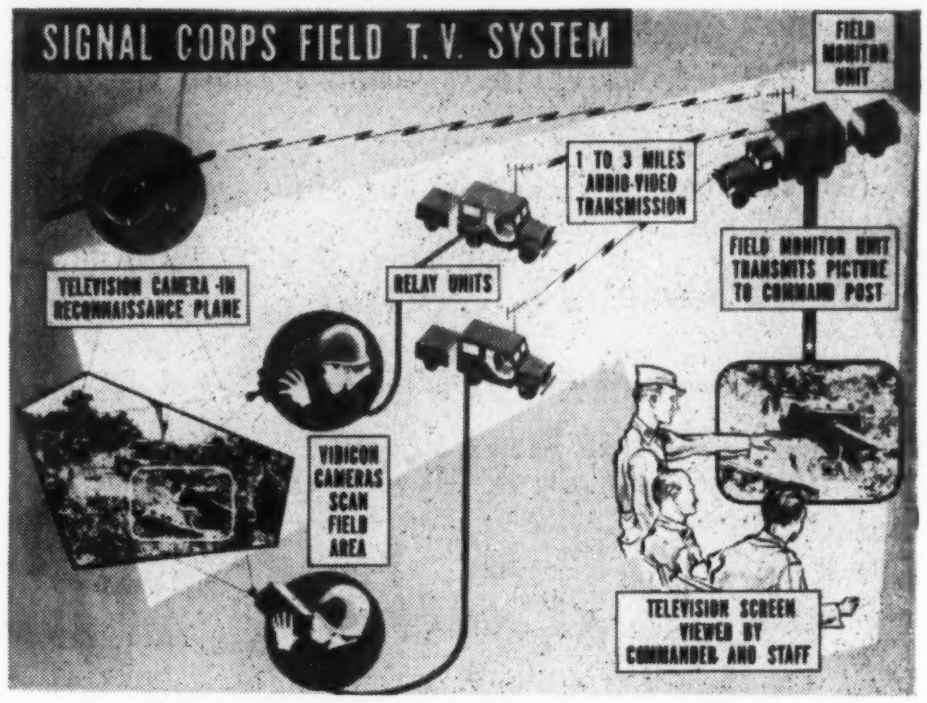
This phase of the study covered a six months period and involved over 3,000 trainees. Four difficult hours of electronics was the subject matter area. However, in contrast to the first phase where the TV instruction was merely the faithful televising of the classroom session, television in this second test was, in effect, turned loose with all the techniques inherent to TV used.

As for the results, reduction in time, in some instances up to 50 per cent, was achieved. In general, little or no training effectiveness was lost and in some cases the teaching effectiveness was improved over regularly presented instruction.

In the field of military training, the potential time saving through the use of television in either basic or technical training can be a most important development. In view of the extensive amount of time presently required for training, any time saved, without practical loss of training effectiveness, can be directly computed in money saved and increased combat efficiency.

This initial study, while establishing the basic fact of TV's effectiveness as a training medium, did not provide all the answers. There was still need for further information on:

(1) Television requirements and procedures for mobilization use.
(2) Television procedures for the achievement of reductions in training time.
(3) Techniques for effective TV presentation.
(4) Training aid requirements and their adaptability and suitability to TV.
(5) Use of kinescope recordings for test, refresher training, dissemination of new developments, and other uses.
(6) The effects of intense TV exposure upon trainee learning.
(7) Television intercommunication between instructor and students.
(8) The use of television as an adjunct to, or supplement to, regular instruction as opposed to its use as a complete substitute for regular instruction.
(9) Determination of instructor requirements for training by television.


SIGNAL CORPS FIELD T. V. SYSTEM
FIELD MONITOR UNIT
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FIELD MONITOR UNIT TRANSMITS PICTURE TO COMMAND POST
TELEVISION CAMERA IN RECONNAISSANCE PLANE
RELAY UNITS
VIDICON CAMERAS SCAN FIELD AREA
TELEVISION SCREEN VIEWED BY COMMANDER AND STAFF

Flow chart for the first interim tactical TV system announced by the Signal Corps.

(10) Use of television facilities for the transmission and use of film and other pictorial products.
(11) The development of television as a testing medium.
(12) Trainee variables such as the relationships of different aptitudes to learning from television.
(13) Evaluation of new equipments.
(14) Specialized military training problems.
(15) Color TV.

To obtain information on these subjects, three projects were initiated and are in effect at this time. A joint TV training study and evaluation project has been established by the Chief Signal Officer at the Army Pictorial Center and the Signal Schools, Fort Monmouth, New Jersey and Fort Gordon, Georgia, to determine some of the answers.

The SCMTVS, redesignated "TV Field Unit No. 1," assisted by a team of audio-visual educational specialists, embarked on a series of survey and evaluation visits to various Army installations having unusual training problems. These include such places as the Armored School, Artillery and Antiaircraft School and the Army Aviation Center.

A joint Signal-Medical study project was initiated at the Walter Reed Army Medical Center in the area of color television. Color TV particularly lends itself to medical application both as a training medium and as an aid in surgical and pathological activities. An extensive, integrated, color TV system is being installed and is partially operative at the Medical Center. The Armed Forces Institute of Pathology is served by this system. It ties in the pathology laboratories, the operating rooms and class and lecture areas. The project, while directed chiefly toward the medical use of color TV, is expected to provide much information on the general subject of military color TV.

Television effectiveness as a training medium has been proven, and through these and other research projects a solid foundation for its future expanded training use is being obtained.

Tactical Applications

Part of the work done by the SCMTVS in 1953 was directed towards the tactical use of TV. Exploratory exercises were conducted, televising various situations and activities that might be encountered under combat conditions. Some of the tactical applications attempted by the Signal Corps Mobile TV Unit were the use of television:

(1) For location, evaluation, and designation of artillery targets and the adjustment and control of artillery fire.
(2) Data transmission.
(3) Intelligence, reconnaissance, and surveillance.
(4) Briefing of tactical commanders.
(5) Observation and control of amphibious landings, river crossings, and assaults.

The results were satisfactory insofar as establishing the *potential* of television as an aid to the tactical commander. However, before its practicability could be determined, it was necessary to test TV in combat-type situations. The Mobile Unit was too cumbersome to be considered tactical. Therefore, the Army Pictorial Center designed and put together an interim tactical TV system.

The system requirements were for small portable ground and airborne equipment, capable of relaying a satisfactory picture from the front lines to the commander and his staff where it could be displayed, coordinated with other intelligence, and evaluated. Commercial equipment, supplemented by standard Army issue gear, was used. Added to this was the airborne system from the SCMTVS.

The interim tactical TV system consisted of three industrial type, hand-held TV cameras operating on cable out of ¾ ton trucks. The signal from these cameras was microwaved back to a base station mounted in a 2½ ton truck, which contained the control and monitoring equipment for the system, the base station to be located at a Regimental or Division Command Post.

As soon as this unit was assembled and field tested, arrangements were made for it to participate in EXERCISE FLASHBURN in April and May of 1954. There it operated as an intelligence-gathering agency, for troop control, as a communications-transmitting device, for air reconnaissance of enemy positions and movement, and for evaluation of captured enemy materiel. However, it was evident that certain improvements in design were mandatory. Almost immediately, jeeps were substituted for the ¾ ton trucks, and for increased flexibility of operation a

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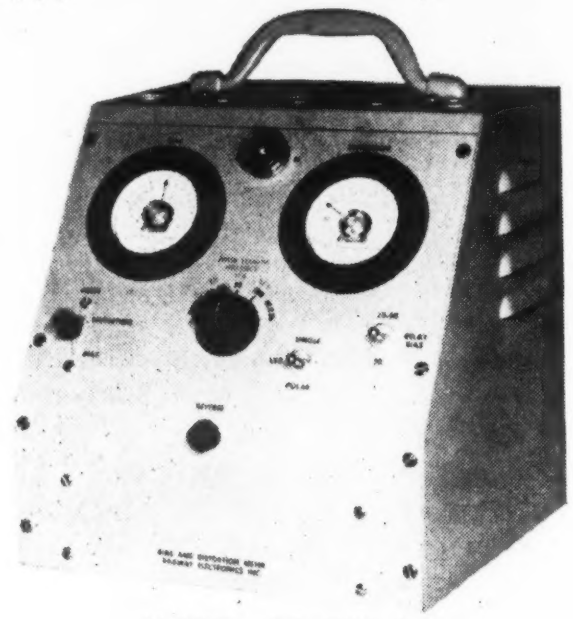

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small, low power TV transmitter replaced the microwave associated with each camera.

The first public demonstration of tactical TV was EXERCISE THRESHOLD, Fort Meade, Maryland, in August 1954. The interim tactical TV unit joined the National Broadcasting Company and the Radio Corporation of America in a nation-wide color telecast demonstrating TV's use in a river crossing, landing, and assault.

The success of the operation was reflected in the comments made at the time on the color telecast:

". . . television will inject an entirely new concept into military communications."—Maj. Gen. George I. Back, Chief Signal Officer, 1951-1955.

". . . The use of television in military operations will provide increased combat efficiency and make possible a substantial saving of lives."—Brig. Gen. David Sarnoff, Chairman of the Board, RCA.

". . . After its possibilities are thoroughly tested, television, as a means of military communication, can take its place beside the atomic cannon, the Skysweeper antiaircraft gun, the NIKE and Corporal guided missiles, and the Honest John rocket as part of our modern Army."—General Matthew B. Ridgway, Chief of Staff, U. S. Army, 1953-1955.

Interim Tactical TV System

The improved unit, used in these and other exercises, led to the design of a more advanced interim tactical TV system. In July 1955, the Army Pictorial Center received this new unit, a compact, mobile television system designed to provide television communications in field situations under field conditions.

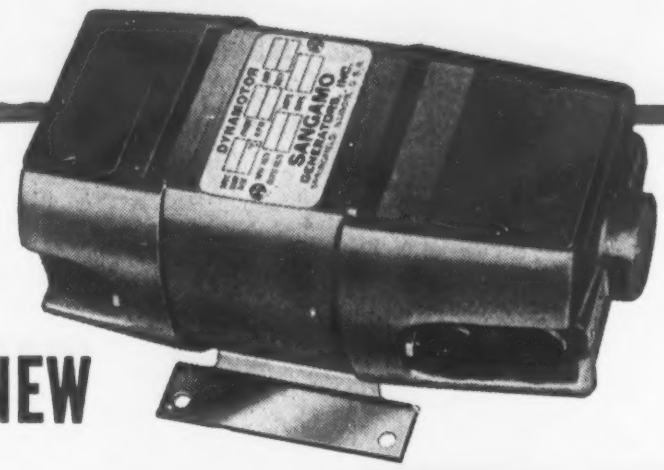
As with the original unit, maximum utilization of the new system provides a television picture from each of four different locations. Three of the pictures are from mobile ground locations; the fourth is a picture from a television camera mounted in a light aircraft. In addition, the unit has the capability of photographically recording still pictures of a television image.

The information from the four sources can be transmitted up to 25 miles to a command viewing site. The signal from the ground cameras is fed by cable to a transmitter mounted in a jeep and then broadcast (a maximum distance of 1 to 5 miles, depending on terrain) to a relay truck assigned to each jeep.

At the relay truck, the video signal is fed into a microwave transmitter mounted on top of the truck. This microwave transmitter is beamed to a technical van at the base receiver site. Maximum distance between the relay van and the technical van varies, depending upon terrain features, up to 20 miles. The technical van receives microwave signals from all three relay trucks.

The light aircraft (L-20) carries two image orthicon television cameras as opposed to one in the original unit. One is mounted in the "belly" of the aircraft. The other has a flexible mounting and is controllable by a cameraman shooting from the side of the aircraft. The signal from either one of the cameras is fed into a transmitter mounted in the aircraft. The airborne transmitter broadcasts the signal to a receiver in the technical van. Distance varies from 10-25 miles.

The technical van maintains technical control of the system and supplies video information from the four picture sources to a command van. Operational control of the elements is maintained by the command van. It has radio contact with all vehicles, cameramen, and the aircraft. The command van is located as close as terrain features permit to the command post of the tactical commanding officer utilizing the television system. The pic-



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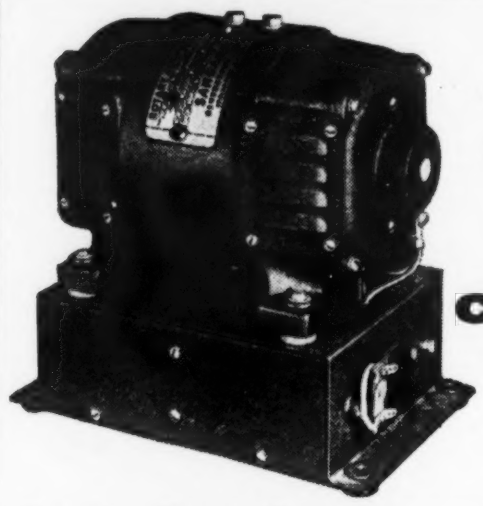

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ture can be viewed in the command van or cabled to various areas in the command post. A specially designed still camera is available in the command van for permanently recording pertinent visual information directly from the face of the receivers.

The television unit described above went through its first complete field test in EXERCISE SAGEBRUSH. This maneuver was of the "free" type having two relatively equal opponents. The television unit was attached to a division reconnaissance troop and its mission was to provide instantaneous visual coverage of the tactical situation for the commander and his staff.

The type of missions performed during EXERCISE SAGEBRUSH, are illustrated by the following excerpts from the television unit's log:

"17 Nov 55. The mission of running airborne road reconnaissance of the Aggressor Army's main route of advance was assigned to the TV Section. Video was transmitted from the airborne pickup station to the command post receiving site. Video reception was acceptable and supplied information concerning road blocks, amount and type of traffic, and general traffic conditions."

"19 Nov 55. Three TV jeeps were dispatched to key points along the main route of advance. Their primary mission was to televise pertinent information to the tactical commander. Vehicle and troop movements were televised. Particular attention was given to traffic bottlenecks and equipment failures or fatalities (umpire scoring). The maximum transmitting range of the video signal from the jeep over heavily wooded terrain was 1.5 and 2.0 miles."

"The TV air mission was to provide coverage along the main line of resistance. Airborne coverage enabled Division Advanced Headquarters to watch the operation of a screened mass movement of large vehicles. The coordinates of this movement were requested and obtained from the camera operator. In this operation, the Division G-2 had TV coverage of an area twenty miles forward of his position."

In general, the newest interim tactical unit accomplished its overall maneuver mission. The maneuver activities provided valuable information pertaining to utilization, special considerations, and definite limitations of this field television equipment.

Special limitations, such as line-of-sight prerequisites for microwave propagation, maximum altitudes for airborne coverage, and cable restrictions between jeeps and cameramen, were still evident. However, the comparison between the older television system and the new unit was encouraging.

Most recent of the Army's tactical television equipments is the man-pack television system, a light, compact, combination of television camera, power unit, and transmitter. The camera weighs only eight pounds and the transmitter, with built-in power supply, forty-seven pounds. Four interchangeable lenses, including wide angle to view a broad sector, and telephoto for distance, are available for diversified tactical employment. The transmitter has a half-mile to a mile range and can operate continually for two hours off its five cell rechargeable battery. Although the receiver portion of the TV system is jeep-mounted for mobility, it may be removed and set up in a fixed location if required.

The new system eliminates the cumbersome cable between the camera and jeep of the original unit. However, the camera can also be used with a cable between the transmitter and the jeep receiver. With power packaged within the transmitter, cable size is one-fourth the size of the one used in earlier models. Its greatest asset, however, is in allowing the cameraman to move over almost any type of terrain without being hampered by accompanying cables.

The recently announced man-pack television camera and transmitter.

Mounted in a jeep is the receiver station of the man-pack system.

The Army has illustrated that tactical television has an overall potential that is at least equal to other major intelligence and communications media. Problems exist. The susceptibility of TV to interference and its requirement for a large segment of the frequency spectrum are some of the major ones. However, TV's ability to provide immediate visual information of critical areas, thus giving the commander "eyes," is a wonderful promise and warrants all the effort expended to date.

TV's Potential Unlimited

In a few short years, television has had a profound sociological, cultural and economic impact on the U.S. Undoubtedly, this will increase as more new practical applications are put into effect and as entertainment TV reaches more new audiences. Its high military potential has been dramatically demonstrated by the work done by the Army to date, and its use by the Army has already become routine in many places. Applications research, equipment improvement and development, and advanced thinking are continuing in an endeavor to determine and establish television's ultimate role as an effective military communications means.

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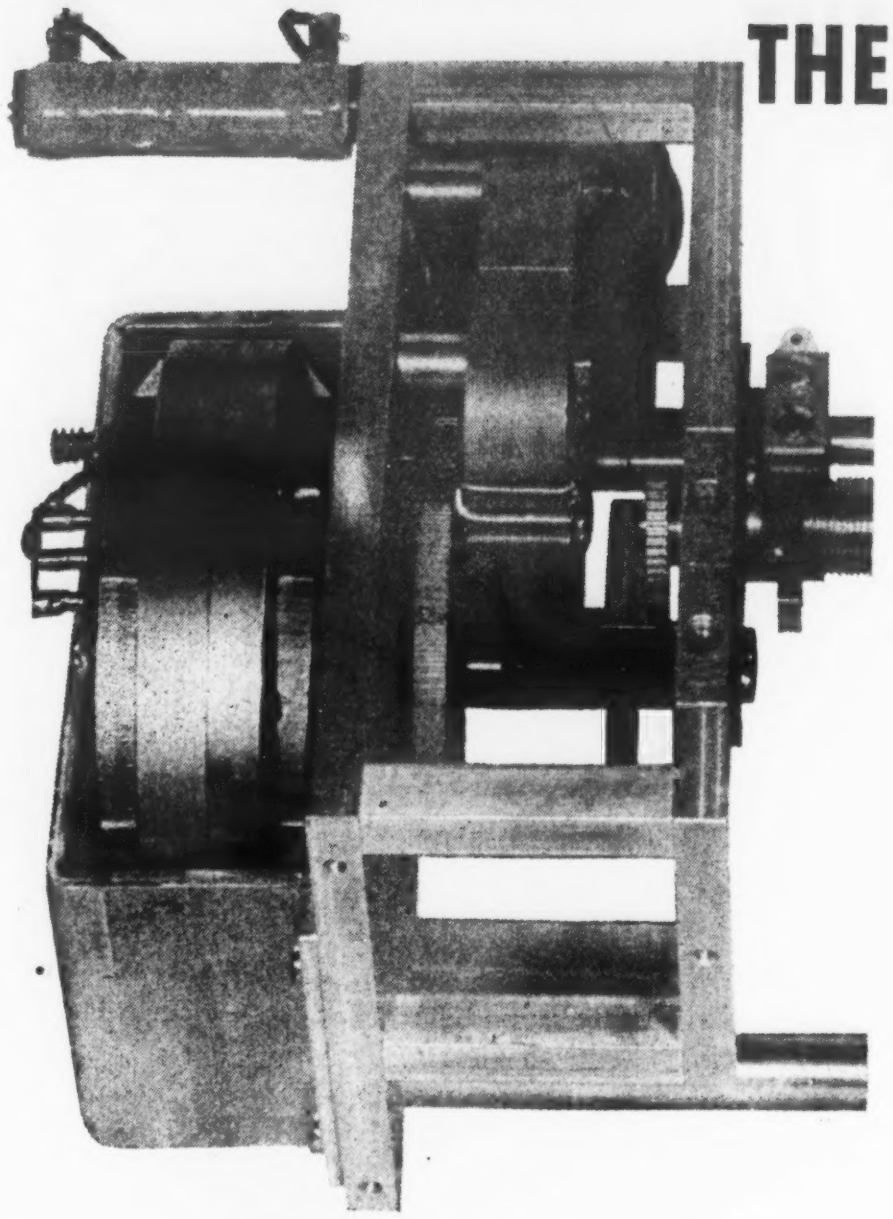

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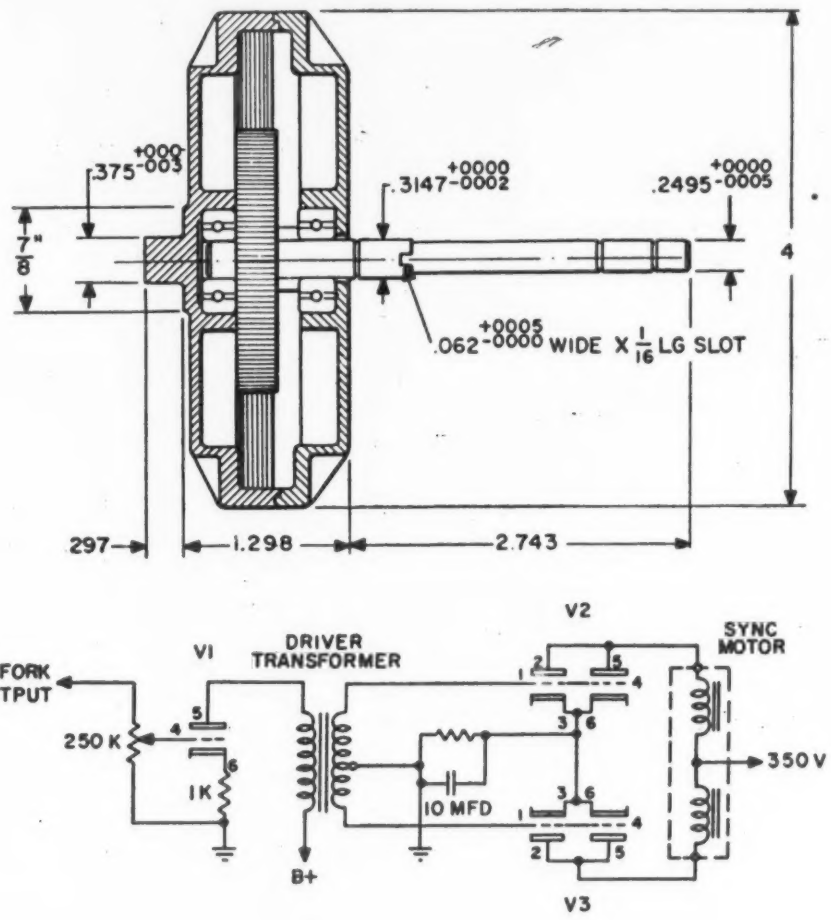
is a phonic wheel type motor capable of operating from vacuum tube amplifiers on signal from frequencies 60 to 4000 cps. It was designed specifically to provide the extremely accurate and invariable speed required for driving fork-synchronized facsimile equipment. The previous model (MS-1) has proved itself by years of continuous duty in communications service. Its unique characteristics will be found the answer to many problems involving the need for constant angular rotation or precise synchronization.

The Model MS-2 Motor can be operated single phase in the plate circuit of a single-ended amplifier or as a two-phase motor when driven by a push-pull amplifier. The latter is recommended since the two-phase connection runs quieter and provides more power with less heating. The motor current is approximately 75 milliamperes per phase. The power input may be as high as 20 watts.



NOTE: Tube types recommended for V2 and V3 are 6SN7GTB, 6BL7, 6BX7 and triode connected beam power pentodes. Selection should be based on power requirements. Cathode resistor is selected to give the desired DC current through the motor windings.

Complete information and prices will be mailed promptly on request.

DESCRIPTION

TYPE — phonic wheel variable reluctance synchronous motor.

DIRECTION OF ROTATION — determined by start motor.

DRIVING FREQUENCIES — 60 to 4000 cps.

NUMBER OF PHASES — 2.

MAX. MOTOR CURRENT — 75 ma per phase.

MAX. POWER INPUT — 20 watts.

MAX. SYNC. TORQUE — 6 in. oz. at 1800 rpm.

MAX. POWER OUTPUT — up to 1/50 hp. depending on input frequency.

SYNC. SPEED — rpm = driving frequency when connected directly in amplifier plate circuit.
Rpm = 2 x driving frequency with AC only.

MAX. INDUCTANCE — .8 h.

MIN. INDUCTANCE — .4 h.

ROTOR INERTIA — 3.2 oz. in.^{2}

MAX. FREQUENCY ACCELERATION —
1000 cycles/sec./sec. from 500 through 2000 cps, no load.

DUTY CYCLE — continuous.

BEARINGS — class 7 precision ball bearings.

WEIGHT — 1½ lbs.

SUGGESTED USES — timing devices, facsimile, commutators, recorders, frequency servo units, variable frequency dividers.

TIMES FACSIMILE CORPORATION

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†*Executive Committee Member, non-voting*

Association Affairs

Officers of the newly organized Orange Chapter: Front row (l to r)—Maj. Donald E. Dobbins, secretary; Fred Cullman, president; Sidney Stevens, 4th vice president. Back row (l to r)—Maj. Walter J. Payne, 2nd vice president; Grattan Hammond, treasurer; and Eugene S. Johnson, 1st vice president. (George Fenton, 3rd vice president, was not present for the picture.)

New AFCEA Chapter

Orange

Petition for charter for the Orange Chapter, with headquarters at Orlando Air Force Base, Florida, was approved by the National Executive Committee at its meeting on April 6th.

The chapter organizational meeting, held on March 22nd, was promoted and chairmanned by Col. F. R. Delaney, commander, 1816th AACS Group, and was attended by nearly 100 representatives of the Armed Services and industry.

Maj. Gen. Dudley D. Hale, USAF, commander, Airways and Air Communications Service, was the distinguished main speaker. He addressed the group on the AFCEA 1956 national convention theme, "Military and Industry: Partners in Progress," and endorsed the organization of the new chapter. Willard L. Moor, president of the Central Florida Chapter, also spoke and described the organizational procedures to be followed in the chapter formation. (See Central Florida Chapter News on page 25.)

A nominating committee headed by Lt. Gen. William E. Kepner, USAF (Ret.), chairman of the board, Radiation, Inc., submitted a slate of nominees for office which was unanimously elected. The officers are: president, Fred Cullman, Radiation, Inc.; vice president, Eugene S. Johnson, Johnson Electronics; Maj. Walter J. Payne, USAF, Air Rescue Service; George Fenton, Electronics Distributors, Inc., and Sidney Stevens, Philco Corp.; secretary, Maj. Donald E. Dobbins, 1816th AACS Group; treasurer, Grattan Hammond, Hammond Electronics.

Other organizations represented at the meeting were: Minute Maid Corp., Communications Div.; U. S. Naval Underwater Sound Reference Laboratories; Southern Bell Telephone and Telegraph Co.; Radio Corporation of America; Strategic Air Command, Pinecastle AFB; Headquarters AACS; Gilfillan Bros., Inc., and Western Union Co.

Introducing AFCEA's New Group Members

The British Thomson-Houston Co., Ltd.

The British Thomson-Houston Company, Ltd., Rugby, England, joined the Association in February.

Serving in the AFCEA as company representatives will be E. A. Buckland, L. J. Davies, E. S. Hall, G. S. Lucas, W. S. Melville, Vernon M. Roberts, A. L. Whiteley, R. S. Gilling, E. V. Small, and T. S. Worthington.

Columbia Broadcasting System, Inc.

The Columbia Broadcasting System, Inc., of New York, N. Y., spe-

Companies Accepted for AFCEA Group Membership Since March 1, 1956

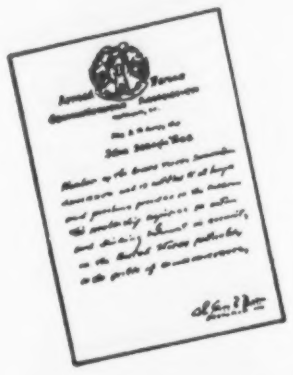
Columbia Broadcasting System, Inc.
New York, New York

Sigma Instruments, Inc.
South Braintree, Massachusetts

Brief notes about these companies are on these pages.

578 new AFCEA individual members from March 1 to May 1

AFCEA Insignia



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ASSOCIATION AFFAIRS

cializing in electronics equipment, communications and research and development, became a group member of the AFCEA in February.

The company representatives in the Association will be: Robert K. Hartman, vice president, CBS-Columbia, Leonard J. Corti, administrator, CBS-Columbia; L. H. Niemann, equipment sales manager, CBS-Hytron Division; Fred H. Garcelon, assistant vice president, CBS-Hytron Division; Peter Reuter, engineering project manager, CBS Laboratories Division; John Christenson, vice president engineering, CBS Laboratories Division; R. T. Capodanno, vice president, engineering, CBS-Columbia; Dr. R. R. Law, director of research, CBS-Hytron Division, and E. K. Whimpy, director of general engineering, CBS-Hytron Division.

Haller, Raymond and Brown, Inc.

The AFCEA welcomed Haller, Raymond and Brown, Inc., of State College, Pa., as a new group member in January.

The following members of the firm have been designated to be company representatives in the AFCEA: R. V. Higdon, president; A. J. Dexter, executive vice president; C. W. Doerr, assistant technical director; W. F. Hittinger, manager, Technical Liaison Department; D. E. Harris, chief, Division I; John P. Walker, Jr., chief, Division II; Glenn L. Musser, chief, Division III; G. E. Knausenberger, chief, Division IV, and L. P. Reilly, manager, Publications Department.

Lenkurt Electric Company

The AFCEA welcomed Lenkurt Electric Company of San Carlos, Calif., back into the Association in January.

The officials included in this membership are: Henry C. Kahrmann, Jr., manager, Government publications; P. B. Patton, vice president; E. G. Hall, sales division manager; R. G. Carpenter, senior sales engineer; Ralph Robertson, contract engineer; A. P. Bowser, sales manager; J. Sherman, manager, military sales; M. A. Heubler, technical writer; J. Naugle, project engineer; L. B. Johnson, general department manager, and H. Leler, technical writer.

North American Philips Co., Inc.

A February addition to the AFCEA is the North American Philips Company, Inc., located in New York City.

The company representatives are: P. van der Berg, R. Pelton, M. Dorenbosch, D. Miller, R. Dettmer, T. J. Moore, J. A. Hipple, T. Schaffers, R. Lowit, and J. Woods.

Sigma Instruments, Inc.

Manufacturers of sensitive relays and counters, Sigma Instruments, Inc., of South Braintree, Mass., became a group member of the AFCEA in March.

Representing their company in the Association will be: R. T. Fisher, president; K. H. Bohaker, sales manager; J. J. Moran, plant manager; J. H. Blaisdell, chief engineer; C. E. Heller, R. B. Wolf and E. S. Fox, district sales managers; H. Walter Lent, engineering representative; G. J. Brodeur and E. A. Bolton, sales supervisors.

Tensolite Insulated Wire Co., Inc.

A recent addition to the AFCEA is the Tensolite Insulated Wire Co., Inc., of Tarrytown, N. Y., manufacturers of insulated wire.

Serving in the Association as company representatives will be C. H. Minich, president; H. J. Von Plonski, vice president, and G. W. Heller, sales manager.

T.M.C. (Canada) Limited

T.M.C. (Canada) Limited of Ottawa, Ontario, joined the AFCEA in January.

Firm officials who will be representatives in the Association are: D. V. Carroll, president and managing director; W. A. Acton, chief engineer; W. Torrington, project engineer; J. C. Vrooman, purchasing agent; C. L. Baker, quality control; T. Hayes, production foreman; G. M. Leach, shop foreman; C. Williams, laboratory assistant; D. Fleming, technical librarian, and G. L. Mortensen, accountant.

In the next issue . . .

A full report with pictures and texts of all the talks given at the 10th Annual AFCEA Convention will be included with the July-August issue of SIGNAL. A perfect supplement to this special issue since the speeches will go further into the topic of "Military and Industry: Partners in Progress."

WILLIAM H. HARRISON SUCCUMBS

William Henry Harrison, 63, president of International Telephone and Telegraph Corp., died on April 21st of a heart attack at his home on Long Island, N. Y. He was one of the earliest members of the AFCEA, his membership dating from 1946.

Beginning his career in communications with the New York Telephone Co. in 1909, Mr. Harrison served also with the Western Electric Co., the Bell Telephone Co. of Penna., the Diamond State Telephone Co. and the American Telephone and Telegraph Co., which elected him vice president in charge of operations and engineering in 1938. Leaving AT&T in 1948, he became president of IT&T.

• His Army rank of major general dates to July of 1943. He served the Government and military in many valuable capacities during World War II and as recently as the Korean conflict took leave from the IT&T to head the National Production Authority in 1950.

VERNON BAGNALL DIES SUDDENLY

Vernon B. Bagnall, assistant director of operations of the American Telephone and Telegraph Company, Long Lines Department, died of a heart attack in Montclair, New Jersey on April 10.

From 1952 until January of this year, Mr. Bagnall served as project manager of the 3000-mile-long Distant Early Warning (DEW) line, the radar warning system across Arctic North America carried out by Western Electric.

During his 29 years with the Bell System he held many key posts. After World War II, he became general commercial manager at Long Lines Department headquarters in New York City and later was named general plant manager and director of personnel. In 1951 he was appointed general manager of the Western area.

From 1951 to 1954, Mr. Bagnall was a national vice president of the AFCEA and a national director from 1951 to 1955.

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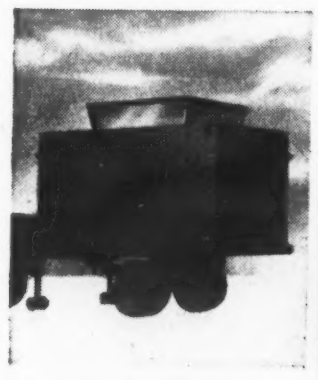

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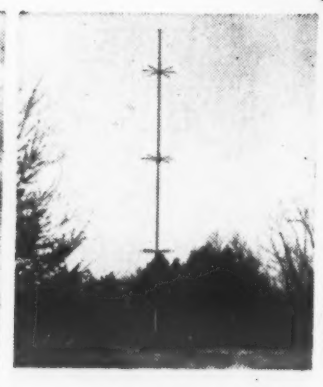

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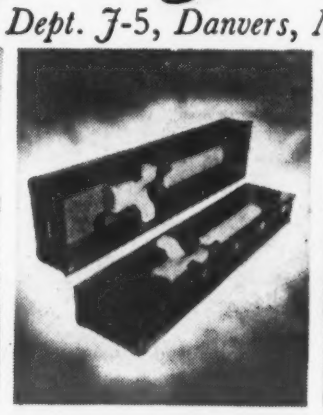

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For transporting and storing plane parts, optical and electronic equipment. Aluminum construction. Built to pass all applicable government specifications.

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AFCEA Group Members

Communications—Electronics—Photography

Listed below are the firms who are group members of the Armed Forces Communications and Electronics Association. By their membership they indicate their readiness for their share in industry's part in national security. Each firm nominates several of its key employees or officials for individual membership in AFCEA, thus forming a group of the highest trained men in the electronics and photographic fields, available for advice and assistance to the armed services on research, development, manufacturing, procurement, and operation.

Admiral Corporation
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Allied Radio Corporation
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American Institute of Electrical Engineers
American Machine & Foundry Co.
American Phenolic Corporation
American Radio Relay League
American Telephone & Telegraph Co.
American Telephone & Telegraph Co., Long Lines Dept.
Ampex Corporation
Anaconda Wire & Cable Company
A. R. F. Products, Inc.
Argus Cameras, Inc.
Arnold Engineering Company
Atlas Precision Products Co.
Audio Products Corporation
Automatic Electric Company
Automatic Electric Sales Corp.
Automatic Telephone & Electric Co., Ltd.
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Barry Controls, Inc.
Bell Telephone Company of Pa.
Bell Telephone Laboratories, Inc.
Bendix Radio
Berkshire Transformer Corp.
Blackburn Electronic Corp.
Bliley Electric Company
Bomac Laboratories, Inc.
British Thomson-Houston Co., Ltd.
Bruno-New York Industries Corp.
Burroughs Corp.
California Water & Telephone Co.
Cambridge Thermionic Corp.
Capitol Radio Engineering Inst., Inc.
Cargo Packers Inc.
Carolina Telephone & Telegraph Co.
Central Technical Institute
Chesapeake & Potomac Tel. Co.
Cincinnati & Suburban Bell Tel. Co.
Clevite Transistor Products, Division of Clevite Corp.
Coastal Publications Corp.
Collins Radio Company
*Columbia Broadcasting System, Inc.
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Convair, Division of General Dynamics Corp.
Copperweld Steel Company
Cornell-Dubilier Electric Corp.
Craig Systems, Inc.
Crosley Division-Avco Mfg. Corp.
Dana, P. A., Inc.
Designers for Industry. Inc.
DeVry Technical Institute
Diamond State Telephone Co.
Dictaphone Corporation
Downing Crystal Company
Dukane Corporation
DuMont, Allen B., Laboratories, Inc.
Eastman Kodak Company
Electronic Associates, Inc.
Elgin Metalformers Corporation
Espey Manufacturing Co., Inc.
Fairchild Camera & Instrument Corp.
Farnsworth Electronics Company
Federal Telecommunication Laboratories
Federal Telephone & Radio Co.
General Aniline & Film Corp.
General Cable Corporation
General Communications Co.
General Electric Company
General Telephone Corp.
Gilfillan Bros., Co.
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Haller, Raymond and Brown, Inc.
Hallicrafters Company, The
Haloid Company
Hammarlund Manufacturing Co., The
Hazeltine Electronics Corp.
Heinemann Electric Company
Hercules Motor Corp.
Hitemp Wires, Inc.
Hoffman Laboratories, Inc.
Holtzer-Cabot Division, National Pneumatic Co., Inc.
Hoover Electronics Company
Hopkins Engineering Co.
Hughes Aircraft Company
Hycon Eastern, Inc.
Illinois Bell Telephone Co.
Indiana Bell Telephone Co.
Indiana Steel & Wire Co.
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West Coast Telephone Co.
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Westinghouse Electric Corp.
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*Company accepted for AFCEA Group Membership since the last issue of SIGNAL.

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The skill behind new Orthophonic "Victrolas" is inherent in all RCA products and services. And continually, RCA scientists strive to open new frontiers of "Electronics for Living"—electronics that make life happier, easier, safer.

New Orthophonic High Fidelity "Victrola" Phonograph, $129.95. 3-Speaker Panoramic Sound System. Mahogany or modern oak finish. Stand extra. (6HF5.) Other instruments to $1600.

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KANSAS CITY: President — William R. Wheeler, AT&T Co., 324 E. 11th St., Kansas City, Mo. Secretary—W. L. Carroll, AT&T Co., 324 E. 11th St., Kansas City, Mo.

KENTUCKY: Inactive.

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National Headquarters Chapters Secretary—Julia B. Godfrey

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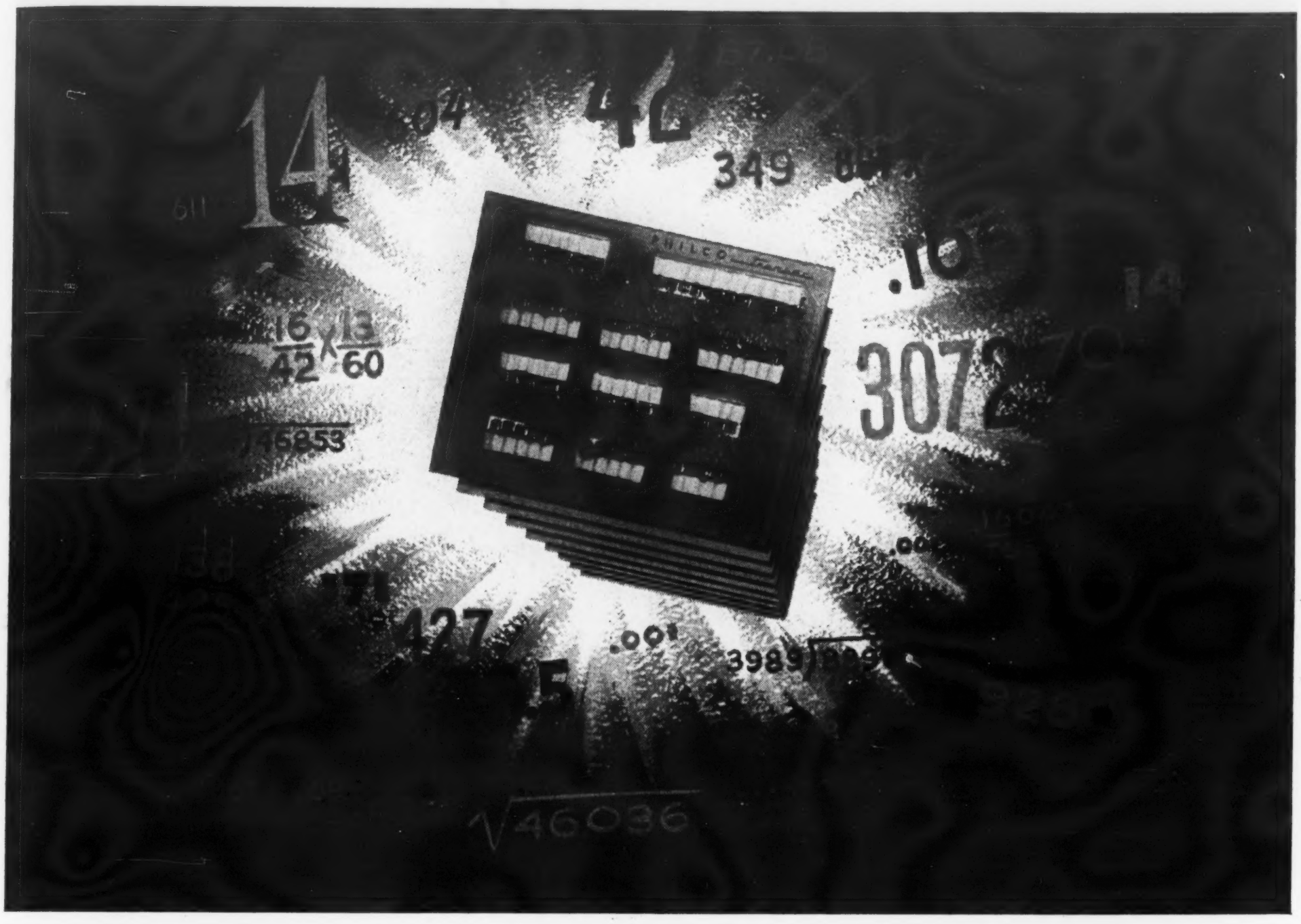

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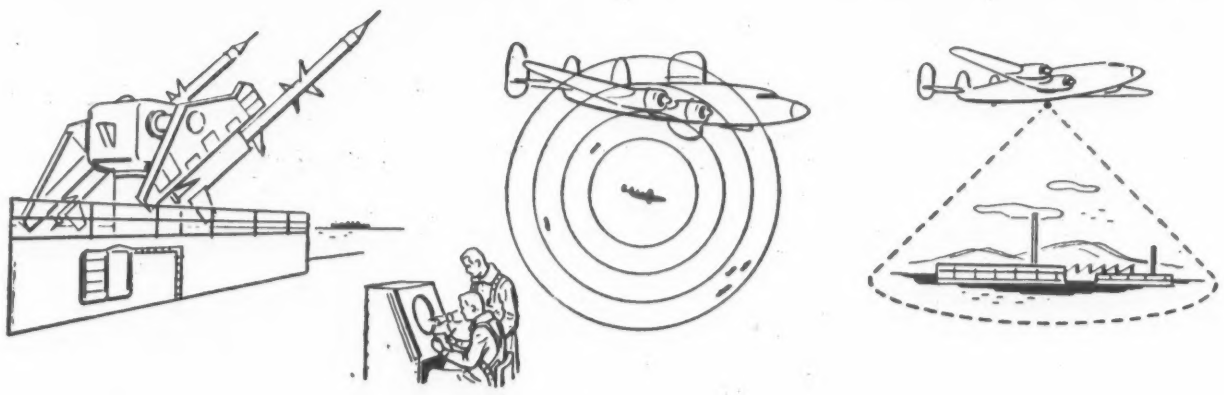

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Chapter News

Atlanta

Some 270 members and guests attended the March 14th dinner-meeting which was addressed by Mr. J. G. Bradbury, Vice President, Southern Bell Telephone and Telegraph Company. Discussing the work of his company, Mr. Bradbury pointed out that he had been close to the military for many years in carrying out his work assignments, and cited the AFCEA for the significant work it does in bringing together men from industry and the Armed Forces who are interested in communications and electronics.

"Our company is 76 years old and is one of 18 operating companies of the Bell System," stated Mr. Bradbury. "We operate in 1,062 towns in the southeast, covering 9 states and we expect to have our 5,000,000th telephone by the end of March." He also pointed out that Southern Bell expects to spend $295,000,000 on construction this year, $312,000,000 during 1957 and that $228,000,000 was spent last year. He compared this with $40,000 spent on construction during the company's first year of business.

The speaker then told something of Altanta's phenomenal growth, pointing out that this is the largest switching center, with 3,600 circuits terminating there. "The telephone is used more in Atlanta than anywhere else in the country. Telephones here carry an average of 7 local calls per day, with each local call traveling a distance of 3¼ miles. We average 37,700 long distance calls per day with an average call covering 114 miles."

Mr. Bradbury then discussed the importance of telephone service for the Armed Forces and told something about how his company provides service where and when needed. He also stated that he sees no let-up in the service demands in the future, that the job would be more difficult but, with the fine co-

Atlanta: Southern Bell Telephone and Telegraph Co. Vice President J. G. Bradbury, guest speaker at the March 14th meeting, is shown conversing with Col. A. R. Morley, chapter president.

operation of the military as experienced in the past, he is certain that their communications demands will be met.

Augusta-Camp Gordon

The program for the February 16th meeting was presented by Maj. John D. Hartline of The Southeastern Signal School, who, with the able assistance of Capt. Ray Downing, gave a comprehensive account of the Reserve Forces Active Training Program.

According to the chapter's custom, following dinner all new members and guests were recognized by the president, John C. Woodward, before proceeding with the business of the meeting. Committee reports were presented by Col. G. W. Rhyne, membership chairman, and John B. Brown, house chairman. It was decided that name plates be obtained and worn by members at each meeting.

"Home Grown Communications" was the subject of the March 15th meeting. The speaker was Mr. J. A. Gus Barrow, local business man and a pioneer in the field of ham radio, who gave an informative account of the invaluable assistance a ham radio operator gives to his community in times of disaster.

Baltimore

Flight Refueling, Inc., was host for the February 21st meeting at its plant near Friendship Airport. Eighty-three members and guests were present.

Charles Speas, supervisor of project engineering, welcomed the group on behalf of John H. Sidebottom, vice president of Flight Refueling. Referring to the principal activity of his company as the advancement of flight refueling techniques, he went on to describe the Probe and Drogue system of flight refueling which the company manufactures for the U. S. Air Force and U. S. Navy. One of the advantages of this system, he pointed out, is the simplicity of making contact, with the

Baltimore: Scene of the luncheon-meeting at Fort George G. Meade on March 24th which was followed by a visit to the Annapolis NIKE site. 155 members and guests attended.

TACAN unit shown with covers removed; plane is a composite model.

~~78-page~~ tube road map for jets

An 800-foot carrier may be as hard to find as a needle in a haystack, when the plane seeking it is at 20,000 feet and the time is 0200 hours.

To make the homing plane a homing pigeon, we build the "ARN-21" TACAN equipment illustrated above. Its 78 tubes and associated components add up to a self-contained transmitter and receiver, rugged in its ride-resistance and accurate to pin-point tolerances.

The manufacture of equipment as important and complicated as this demands *perfection*, and nothing less. On the military as well as the home front, Stromberg-Carlson has long displayed the ability to take such problems in stride.

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refueling operation always under the control of the pilot of the plane receiving fuel. The compact, light-weight tanker unit can be installed on Air Force jet fighter-bombers or Navy carrier-based planes.

An interesting sound film showing the actual procedure of refueling planes while in flight was shown. This was followed by a conducted tour of the production and assembly departments of the plant.

Highlight of the March 24th meeting was a visit to the Annapolis NIKE site, with 155 members and guests participating.

The afternoon's activities began with a social hour and luncheon in the Officers Club at Fort George G. Meade. Chapter President Henry B. Yarbrough introduced Maj. Gen. R. R. Hendrix, commander of the 2nd Anti-Aircraft Regional Command, and other distinguished guests.

The transfer of one of the chapter's most loyal supporters was marked by a special ceremony. Col. Charles M. Baer, former Signal Officer, Second Army, and a vice-president of the chapter, was presented a plaque by the Baltimore Chapter which read: "To Colonel Charles M. Baer—in deep appreciation for his outstanding cooperation in fostering a better understanding between industry and the military." This plaque was given to Colonel Baer with the members' best wishes on his new assignment in Europe as United States representative to NATO.

General Hendrix described the mission of the 2nd Anti-Aircraft Regional Command, and Capt. L. Richolt, battery commanding officer, briefly covered some of the equipment to be seen at the NIKE site. Following adjournment at Fort Meade, the group was taken to the site in buses.

At the NIKE site, the members first saw the missile launchers which are housed underground and brought to the surface on platform elevators. Next stop was the fuel loading platform, the overall length of which is 32 feet (20 feet missile and 12 feet booster). At 12,000 feet, the missile begins to make a turn over and down into the target, the booster leaves the NIKE and falls into a booster disposal area.

The AFCEA contingent also learned that the NIKE Command Guidance System consists of three radars housed in two vans: the Acquisition Long Range Radar, Target Track Radar and Missile Track Radar. The NIKE sites are manned twenty-four hours a day, seven days a week.

Also visited were the enlisted quarters, officers' quarters, the PX and the communications and First Aid station.

Credit for the chapter's excellent programs goes to the program committee consisting of Adam A. Fiedler of Bendix Radio, chairman, and Lt. Col. E. T. Rhatigan, Fort George G. Meade.

Chicago: The Teletype Corp. was host to the chapter on January 26th. During a tour of the production area (above), members and guests pause to inspect a Model 15 printer test line.

Baltimore Chapter honors an old friend. Shown during the presentation of a special plaque to Col. Charles M. Baer are, left to right: President Henry B. Yarbrough, Maj. Gen. R. R. Hendrix; Regional Vice President George C. Ruehl, and Colonel Baer.

Boston

Raytheon's new research laboratory in Wayland, Mass., was host to the chapter on April 5th.

The contingent of 125 members and guests was welcomed by Fritz A. Gross, manager of the Wayland Laboratory, and was given an opportunity to examine a display of Raytheon's commercial equipment. A conducted tour of the facilities of the laboratory followed.

Prior to the visit to the laboratory, the members and guests met for a social hour and dinner at Robinhood's Ten Acres restaurant in Wayland.

Central Florida

Members of the recently chartered Central Florida Chapter traveled to a meeting at Orlando Air Force Base on March 22nd which had a two-fold purpose: to hear an address by Maj. Gen. Dudley D. Hale, commander of Airways and Air Communications Service, USAF, and to proceed with the organization of a separate chapter of the AFCEA in the Orlando area. The successful organization of the new chapter, known as the Orange Chapter, is reported under Association Affairs on page 50 of this issue.

General Hale addressed the gathering of nearly 100 representatives of the Armed Forces and industry on the theme of the association's 1956 convention—"Military and Industry—Partners in Progress."

"The communications industry is in a period of great transition," General Hale told his audience. "It is moving so fast no one can accurately say where we are going.

"This organization provides the best means possible of meeting to exchange ideas and give the military and industry an opportunity to become better acquainted."

Chicago

Mr. J. M. Bridges, Director of Electronics, Office of the Assistant Secretary of Defense (Applications Engi-

neering), was guest speaker at the chapter's March 1st meeting which drew an attendance of 225 members and guests.

The subject of Mr. Bridges' address was "A Military-Industry Program to Improve the Reliability of Military Electronic Equipment" — see "Quotes in Review" on page 58.

Motorola, Inc., was host to the chapter at its Franklin Park plant.

Dayton-Wright

The chapter's February 1st meeting was held at the Van Cleve Hotel and was devoted principally to items of business and plans for future programs.

A film entitled "The Eagle's Strength" comprised the program portion of the meeting.

Decatur

Formal installation of the newly elected officers took place at the January 27th meeting at the Decatur Signal Depot. Lt. Col. Fred J. Hays is the

J. M. Bridges, Director of Electronics, Office of the Assistant Secretary of Defense (Applications Engineering) shown addressing the Chicago Chapter.

new president. The other officers are: 1st vice president, James F. Torbett; 2nd vice president, Roman W. Wojcicki; secretary-treasurer, CWO Alfred A. Mulzet; member executive committee, Col. Edwin G. Fritz, past president.

Members of the board of directors are: Maj. Frank P. Bellusci, Maj. Joseph J. Rein, Jr., Elmer W. Cupp, David W. Richardson and Thomas K. Grennan.

Lt. Col. Robert A. Grohne officiated as installing officer.

An interesting and varied program was presented by the Decatur Toastmasters Club. Col. Emerson A. Schultz, a former president of the AFCEA chapter, acted as chief toastmaster.

At the conclusion of the meeting, buffet refreshments were served in the Officers Mess. This recent innovation of the chapter is successfully serving a two-fold purpose—it provides a fellowship hour and also gives the members an opportunity to discuss the evening's program.

Amateur radio was the theme of the February 23rd meeting, with 45 members and guests in attendance. Robert W. West, president of the Central Illi-

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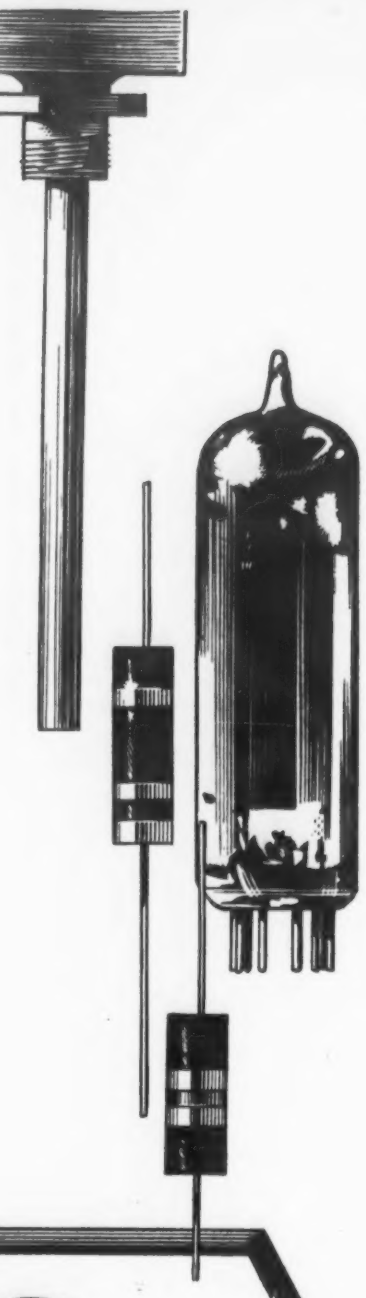

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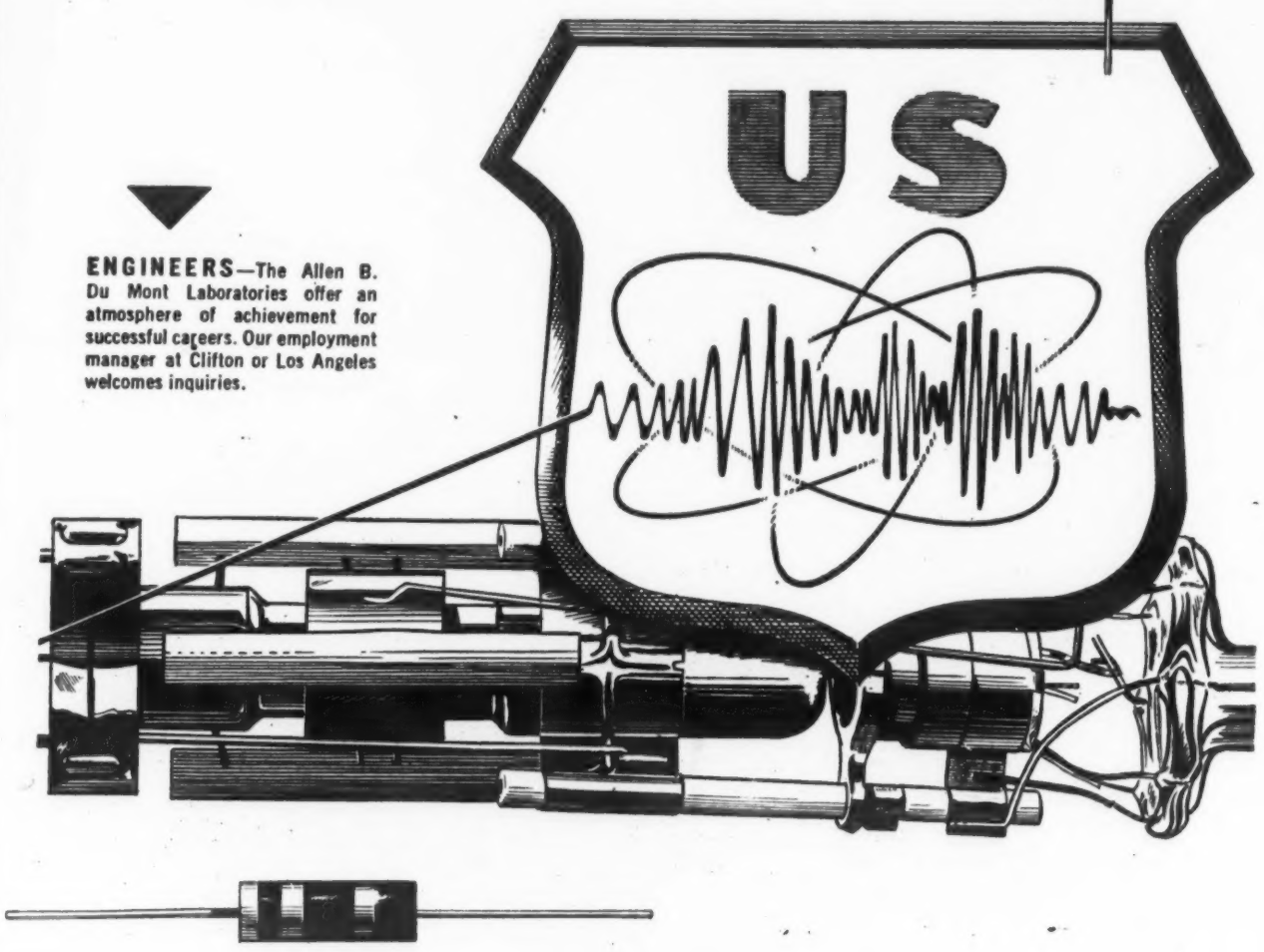

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nois Amateur Club, and other members of the club traced the development of amateur radio from its early days to the present. Their presentation included various demonstrations of equipment.

Detroit

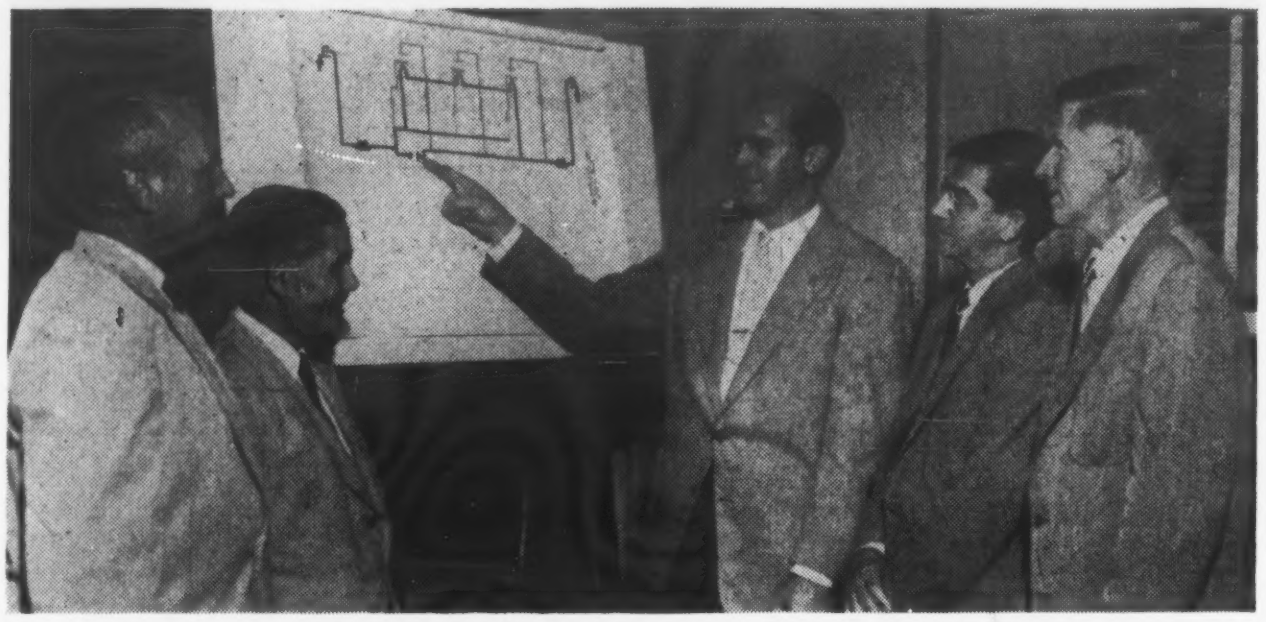
A tour of the facilities at Wayne University featured the chapter's February 23rd meeting, which was preceded by dinner at the Student Center.

Particular emphasis was placed on the following highlights of the tour: the Computation Laboratory; the new Engineering Building, including the Electronics Section of the Department of Electrical Engineering; and the new Science Building, including the Department of Physics.

Among the members and guests were representatives of the Army, Air Force and industry. The chapter's new group member, the Burroughs Corporation, was represented by R. L. Lancaster, district defense sales manager; P. S. Mirabito, defense contracts general manager, and A. P. Diamond. Traveling the greatest distance were Frank W. Ward and four guests from the Clark Equipment Company in Battle Creek.

Arrangements for the outstanding meeting were made by George Goldstone, a former president of the chapter, and Dr. Jerry Sevick, Associate Professor of Physics at Wayne, who participated in planning for both the dinner and the tour. Professor Howard Hess, head of the Electrical Engineering Department, contributed immeasurably to the success of the tour.

Wayne University is a part of the Detroit Board of Education and receives little financial support from any other source. It is presently the thirteenth largest university in the country and the Detroit Chapter reports that its facilities and accomplishments amazed many of the AFCEA members participating in the tour.



Hawaii: During a tour of the Hawaiian Telephone Co., Edward Shoen, electronics engineer, points out some highlights to: Brig. Gen. H. L. Schofield; Chapter President L. W. Robello; Martin Springel, and D. S. Guild, operating vice president of the telephone company.

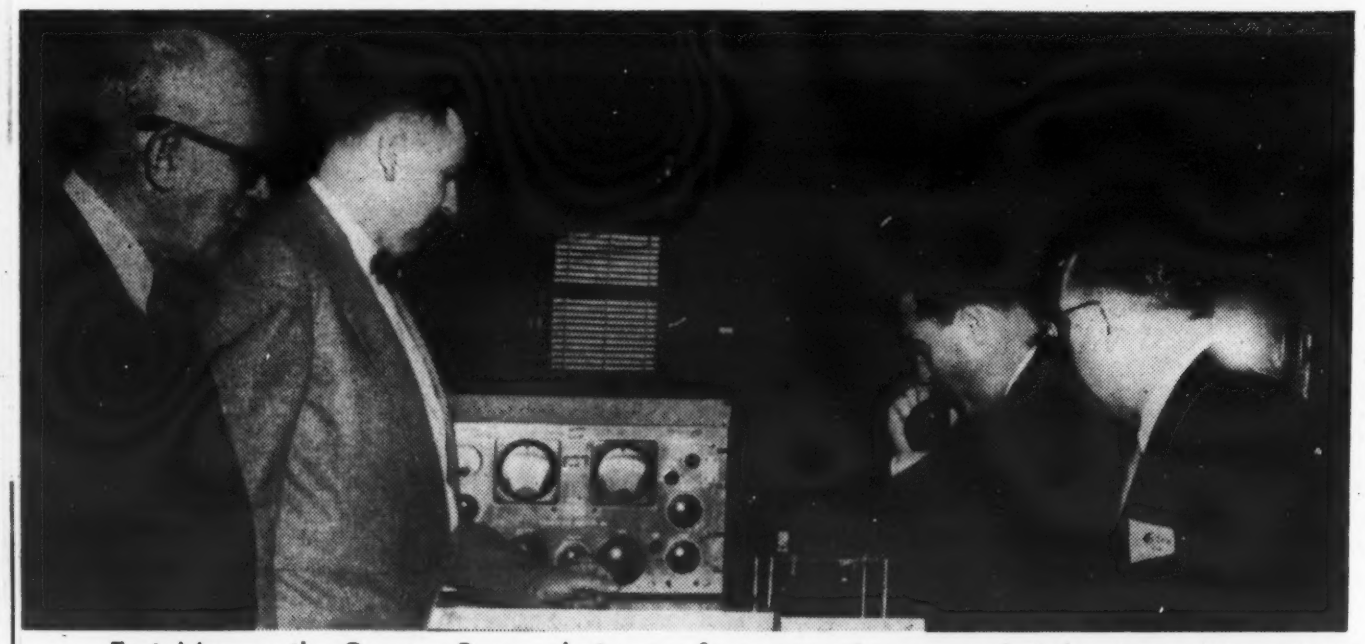
Fort Monmouth

Bells rang for the Fort Monmouth Chapter during its February 16th meeting at Gibbs Hall. The bells were a part of a singular demonstration of "Bells, Electronic Carillons and Chimes" by Frank H. Slaymaker of the Stromberg-Carlson Company of Rochester.

National AFCEA President George W. Bailey was guest speaker at the dinner-meeting on March 15th. He praised the chapter for its standing as the second largest unit of the Association, and then gave an overall report on national AFCEA activities.

The evening's program featured a demonstration of a recently announced voice-powered radio transmitter now under experimental development at the Signal Corps Engineering Laboratories. The demonstration of the unique device was presented by George Bryan, its designer.

Mr. Bryan showed how speech waves of the human voice are all that are needed to power the small transmitter which fits into an ordinary telephone mouthpiece. It can now broadcast a distance of 600 feet, and soon may be increased to cover a mile through higher frequencies and matched antennas.



Fort Monmouth: George Bryan, designer of a new voice-powered radio transmitter, shows guests at the March meeting how this unique experimental device operates. Left to right are: George W. Bailey, AFCEA National President; Brig. Gen. Earle F. Cook, commander, SCEL; Mr. Bryan, and Col. Fred P. Elser, chapter president.

Gulf Coast

Regular monthly meetings were resumed in January. James C. Dabney of Southern Bell Telephone and Telegraph Company presided and plans were made for activities which would create a sustained interest in the chapter and the Association. The reactivation program was initiated by Gol. William N. Snouffer, commander, 3380th Technical Training Group, Keesler Air Force Base.

Program feature of the February meeting was an interesting talk on Chinese communications problems. The speaker was Colonel Chen, a signal officer in the Nationalist China Army.

Election of new officers took place at the March 5th meeting, with Maj. Don L. Poling of Keesler AFB, chosen to head the chapter during 1956-57. Other officers elected are: 1st vice-president, Ancil Z. Arseneau, Keesler AFB; 2nd vice-president, Lt. Col. Julian Dendy, TecTAF; 3rd vice-president, George D. Sheffield, Southern Bell; secretary, W. F. Blacklidge, Southern Bell; treasurer, Capt. Robert B. Miller, Keesler AFB.

The April 2nd meeting was held at Baricev's Restaurant in Biloxi. Arrangements were made to send a delegate to the national convention in Boston—President Don Poling was selected to represent the chapter.

Capt. W. W. Cory, chapter member from Keesler AFB, conducted the program session. His subject was the emergency capabilities and proposed emergency plans of the local power company, the telephone company, and the radio stations.

Hawaii

The Hawaiian Telephone Company was host to 46 chapter members and guests at a dinner-meeting in January.

Following dinner, a series of talks on "Underseas Telephone Communications" was presented by members of the engineering department of the Telephone Company. Those participating were: Robert Lowrey, chief engineer; Edward Schoen, electronics engineer;

Close-up shows a General Electric 5-Star subminiature tube structure being inserted in its bulb, or envelope—similar to those the inspector at left is examining. Flared ends of the bulbs guide the snug-fitting mica tube spacers into the envelope without damage to their contact points.

Flared ends of G-E 5-Star subminiature tube bulbs assure close fit of tube structure!

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and Ray Alden, supervisor of transmission and protection engineering.

A dinner-dance at the Cannon Club at Fort Ruger on February 25th marked the February activity of the chapter.

A new member of the chapter's executive board is Cdr. Truman E. Turnipseed, formerly of the Washington Chapter and now Executive Officer of the U. S. Naval Communications Center at Pearl Harbor. Commander Turnipseed was appointed vice president of the chapter and chairman of the national security and liaison committee to fill the unexpired term of Cdr. Arvell B. Ward.

Kansas City

William R. Wheeler of the American Telephone and Telegraph Company was elected chapter president at the annual elections on April 3rd. The other new officers elected were: vice presidents—Col. Gus B. Hoffman, Grandview Air Force Base; J. T. Wallingford, Central Technical Institute; and LCdr. Edward J. Beckman, Olathe Naval Air Station; secretary-treasurer—W. L. Carroll, AT&T Company.

Board of Directors: Lt. Col. M. C. Brown, Grandview Air Force Base; Jay V. Wilcox, Wilcox Electric Company, Inc.; C. L. Buell, Western Union Telegraph Company; A. J. Esrey, AT&T; E. L. Parkington, Western Union; R. E. Conrath, AT&T; W. Glenn Rider, Rider and Philpott, photographers; J. E. Hoy, Southwestern Bell Telephone Company; R. W. Lee, Wilcox Electric, and J. G. Kreamer, United Telephone Company of Missouri.

Retiring Chapter President Carroll S. Miller, Wilcox Electric Company, took the occasion to announce that he was moving to Orlando, Fla., on June 1st and that he regretted severing his pleasant association with the Kansas City Chapter.

The program for the evening was prepared by Mr. W. Glenn Rider, a commercial photographer and longtime member of the chapter. Program material consisted of a series of 3-D stereo color photographs which were projected on a special screen and viewed through special American Optical polarized viewing glasses. The pictures were of familiar local scenes, and well known scenes in New York, Philadelphia and Washington, D. C.

Special guest of the chapter was Lt. Col. George D. Meserve, past president of the Montgomery Area Chapter at Maxwell Air Force Base.

New York: Lt. Col. Dale R. Tidball, Deputy Chief, Air Defense Engineering Services, Project Office of the Air Materiel Command, guest speaker at the February meeting, is shown at the microphone with Chapter President Stanley F. Patten.

London

A tour of the Decca Radar, Ltd., plant at Malden Way, Surrey, featured the chapter's January 12th meeting. Arrangements for the occasion were made by Mr. H. F. Schwarz, director, Decca Navigator Co., Ltd., and G. C. E. Fennessey, director, Decca Radar, Ltd.

On March 2nd, chapter members met at Ruislip Air Base to witness a demonstration of USAF communications equipment staged by members of the 1821st AACS Group.

Detailed reports of these meetings had not arrived at national headquarters as SIGNAL went to press.

Montgomery

On February 23rd, the Montgomery Chapter said farewell to Lt. Col. George D. Meserve, past president and founder of the chapter, who was retiring from active service. Colonel Meserve was honored at a cocktail party and dinner attended by numerous AFCEA members and guests.

New York

A discussion and a film presentation of the SAGE system developed for air defense featured the February 29th meeting at the Belmont Plaza Hotel.

Lt. Col. Dale R. Tidball, Deputy Chief, Air Defense Engineering Services, Project Office of the Air Materiel Command, told the chapter members that development of SAGE (Semi-Automatic Ground Environment) provides a counter-balance to the many advantages which a potential attacker would have. He pointed out that the United States assumes the role of defender as a matter of national policy, and the defender has ever-decreasing time to muster its forces before nuclear weapons can destroy the means with which to resist.

"In the SAGE system," said Colonel Tidball, "the digital computer can make calculations in six microseconds as information is fed into it from the various warning services."

The operations of the system were illustrated by a recently de-classified

Louisiana: Scene during the January meeting at the Coast Guard Station Officers' Mess. Seated (l to r): Brig. Gen. Robert V. Maraist, Director, New Orleans Civil Defense; Dr. Joseph C. Morris, Prof. of Physics, Tulane Univ., guest speaker; Charles Pearson, Jr., chapter president, and Brig. Gen. Francis A. Woolfley, State Director of Civil Defense. Standing (l to r): Capt. W. C. Jonson, CO, Naval Air Station; Lt. Col. L. W. Davis, State Director of Selective Service; Guy Bannister, Asst. Supt. of Police; Vice President W. Ray Gordon; Secretary Bruce Hay; C. C. Walther, past president; Anthony Devoney and Paul Cordes, co-chairmen, arrangements committee; Capt. H. W. Stinchcomb, commander, 8th Coast Guard District, and Dr. W. P. Gardiner, Director, New Orleans Health Dept.

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color film prepared at the Lincoln Laboratory of the Massachusetts Institute of Technology. The film illustrated how information about the attacker is fed to the computer center, and the resulting calculations relayed to the appropriate means of interception and defense.

"Modern Photographic Techniques for the Jet Age" was the topic of a slide illustrated lecture at the March 28th meeting. Presented by Raymond G. Hennessey, Assistant Marketing Manager for the Reconnaissance-Systems Division of the Fairchild Camera and Instrument Corporation, the talk dealt with the tailoring of a present day reconnaissance system to meet jet age needs, as well as a discussion of new techniques in the development stage at Fairchild.

Mr. Hennessey stated that the speeds of modern jet airplanes required very complex photographic equipment, automatically controlled, which can be used at very high altitudes and still give over 99% reliability. He demonstrated a number of cameras made for the Air Force by Fairchild, and showed colored slides illustrating the system operation of several cameras used on aerial photographic missions.

During the meeting, Chapter President Stanley F. Patten announced the following members of the New York Chapter had been honored recently by being elected Fellows of the Institute of Radio Engineers: Nichols G. Anton, George W. Bailey, Julian Z. Millar and Carl E. Scholz.

North Carolina

A dinner-meeting celebrating the chapter's organization was held on March 1st in the ballroom of the Fort Bragg Officers Open Mess.

Honor guests were: Maj. Gen. D. V. Johnson, Deputy Commanding General, Third Army; Maj. Gen. Paul D. Adams, Commanding General, XVIII Airborne Corps and Fort Bragg; Brig. Gen. P. R. Weyrauch, Deputy OCSigO, Washington; and Brig. Gen. William P. Pence, representing the Chief Signal Officer.

General Pence congratulated the newly formed chapter and Luke W. Hill, president of the Carolina Telephone and Telegraph Company and a vice-president of the chapter, expressed his appreciation for the support given the chapter by the communications and electronics industries in North Carolina.

National Executive Vice President George P. Dixon had been scheduled to be the guest speaker and officially present the chapter charter, but illness necessitated the postponement of his visit.

Standing committees were appointed at the April meeting by Col. Charles A. Stanley, chapter president, as follows:

National security—James K. Avent, Capt. H. L. Fetterhoff and Frank A. Bush; finance—Ed Johnson, Maj. W. V. Horne and L. M. Raby; reserve activities—Col. Henry J. Hort, G. R. Sacksteder and W. J. Keane; liaison—Joe S. Stone, Robert R. Lyon and Thomas K. McLaughlin; publicity—J. R. Haven and Lt. Col. Fred W. Hemmrich.

Following the business meeting, John Moore of the Southern Bell Telephone and Telegraph Company, Charlotte, presented a demonstration on microwaves.

North Texas

A tour of the Bell Aircraft Corporation plant at Hurst, Texas, was the highlight of the February 27th chapter activity.

Chapter members were escorted through the plant to observe the details of production of various models of Bell helicopters. Special attention was given to the engineering departments and their various testing methods. A thirty-minute film depicting the uses of the helicopter in both commercial and military applications was shown, with a brief seminar concluding the program.

The group then adjourned to the People's Cafe in Arlington for a social hour and dinner.

Election of officers took place at the March 26th meeting, with Lt. Col. R. H. Vinding, Fort Worth General Depot, chosen as the new president. Capt. John H. Warburton was elected vice-president and John W. Williams, secretary-treasurer.

Maj. Gen. Dudley D. Hale, USAF, guest speaker at the organization meeting of the Orange Chapter on March 22nd.

Col. T. F. Yates, Southwestern Bell Telephone Company, addressed the dinner-meeting on the history and mission of the Association.

Northwest Florida

A dinner-meeting at Eglin Officers Club on March 2nd marked the beginning of the chapter's second year of operation. The new officers who were elected at the February meeting (reported in March-April SIGNAL) were formally installed.

Lt. Col. Walter G. Wilson, chapter president, discussed plans for future activities and asked for the support of all members in achieving the year's objectives.

Paris

The chapter held a dinner meeting on March 19th at the Cercle Militaire, Place St. Augustin, Paris. Forty-eight members and guests attended the meeting which was conducted by Maj. Gen. E. Blair Garland, Chief Signal Officer, SHAPE, as vice-president of the chapter in the absence of the president.

•Guests included: M. G. Nouvion, Ingenieur en Chef de la S.N.C.F., guest speaker; M. E. Mugniot, President de la Societe Lignes Telegraphiques et Telephoniques; Dr. M. Deloraine, Technical Director, International Telephone and Telegraph Company; M. T. T. Debre, president of Compagnie Industrielle de Telephone; M. G. Rabuteau, Director General, Le Materiel Telephonique; Dr. M. Ponte, President of Compagnie General Sans Fil; General E. Combaux, D.E.F.A., Brigadier E. S. Cole, Deputy Chief Signal Officer, SHAPE.

The dinner was followed by a few remarks from General Garland and the recognition of the special guests.

A short talk and film was presented by M. G. Nouvion. the engineer in charge of the record-breaking trial runs of the French railway train. The presentation included a discussion of the preparations necessary for the control and timing of the tests where a speed of 205 miles per hour was

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Pittsburgh

The master minds of the Pittsburgh chapter never seem to run out of ideas for chapter programs. Their latest, and very successful, innovation was a theater party on February 23rd which was rated tops for entertainment and fellowship.

A reserved block of seats at the Playhouse Theater accommodated 101 AFCEA members and guests. The play was a delightful comedy, "Mornings at Seven." Prior to curtain-time, the group enjoyed cocktails and dinner in the Playhouse Restaurant.

Returning to the serious phase of activity, on March 25th the chapter visited the NIKE site in North Park, Pittsburgh, and was treated to a first-rate tour of B Battery's 1st Anti-Aircraft Missile Battalion.

A complete operational demonstration was performed of the fire controls system and a demonstration was made of the radar installations at this station. The group was then taken in buses to the launching site where a simulated firing demonstration was made to show the rockets and how they would be fired in the case of an alert. The men assigned to the NIKE station were most cooperative and answered all questions which security permitted.

Arrangements for this exceptional program were made by Maj. John T. Dabinett, Signal Corps' assistant PMST. Carnegie Tech. and vice-president of the chapter.

Rocky Mountain

A wide variety of subject matter has been featured at meetings this fall and winter, and membership in the chapter has doubled since its organization in April 1955.

Some of the programs were as follows: October—a lecture-demonstration on color TV by Cyril N. Hoyler of RCA; December—General Electric lecture-demonstration on automation in the electronics industry; January—demonstration of basic electronic computers by Dr. Howard Griest, Hughes Aircraft Co.; February—presentation of Sperry A-12 Gyropilot by Sperry Gyroscope Co., and March — "Air Power, 1956" presented by the Bendix Aviation Corp.

San Francisco

On March 23rd, the chapter held its annual ladies' night at the Fort Mason Officers Club in San Francisco. A social hour and dinner were followed by an evening of dancing, with sixty-five members and guests present.

During the dance intermission, the Eastman Kodak Company presented an interesting color movie entitled "M-Day for the Spencers." This amusing film—selected with an eye to the ladies—deals with the trials of a moving day and ends happily when everybody is pleased about a new decorative effect.

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CHAPTER NEWS

North Carolina: Above, Brig. Gen. Wm. P. Pence and Luke W. Hill. Right (l to r): Col. Charles A. Stanley: Mrs. P. R. Weyrauch; Maj. Gen. Paul D. Adams; Mrs. T. P. Williamson, and Brig. Gen. P. R. Weyrauch.

Scott-St. Louis

"The DEW Line Radar Network" was the program subject of the March 2nd dinner-meeting and was presented by Robert B. Alexander of New York, a member of the Western Electric team assigned to supervise construction and installation of this project across Alaska and Northern Canada.

Mr. Alexander supplemented his talk with two films, each an outstanding example of remarkable color photography under conditions far from ideal. The films demonstrated how well the military and industry worked together to make the project a success. They also showed the methods improvised to solve the seemingly impossible problems of construction and installation.

Annual elections on April 6th brought the following slate into office: president—Walter W. Van Skiver, Scott AFB; vice presidents—RAdm. Robert E. Melling, USN (ret)., and Elmer J. Weber, Southwestern Bell Telephone Company; treasurer—Prosper L. Kinsella, Scott AFB; secretary—Allan L. Eisenmayer, Scott AFB.

The new board of directors: Lt. Col. Charles H. Colman, Scott AFB; Lt. Col. John L. Jernigan, ATC, Scott AFB; Capt. James D. Porter, AACS, Scott AFB; Harry L. Cooper, AT&T; James G. Blain, Western Union; Louis E. Dechant, Dechant Electric, and Lt. Col. William J. Trigg, USAF, Missouri ANG.

The program featured "Hi-Fi and You," an operational demonstration and discussion of the high-fidelity system of audio or sound reproduction. Elmer E. Brockman of the Farnsworth Electronics Co., Fort Wayne, and Henry J. Strackeljahn of Scott AFB, conducted the presentation.

South Texas

Stephen H. Simpson, Jr., Southwest Research Institute, was elected president of the chapter on February 29th. Other officers chosen during the annual elections were: vice presidents—Col. James E. Dupree, SigC; Ben F. Givens, Southwestern Bell Telephone Co.; and Col. Albert H. Snider, USAF; secretary—S. J. Keane, Southwest Research Institute; treasurer—Bennette O'Bannon, Philco Corporation.

Directors: Maj. Gen. Harold H. Bassett, USAF; Ross Irwin, Audiphone Company; Otto Koecher, chief engineer, Fourth Army; Morris McGee, Western Union Telegraph Co.; Col. Francis B. Morgan, USAF, and Col. George Richon, SigC.

Standing committees were appointed as follows: membership—Ralph N. Ness, Graybar Electric Company, Inc.; program—Col. James E. Dupree; publicity—Branch T. Masterson, Hearst Advertising Service.

The evening's guest speaker was Harold S. McCrabb, forecaster of the San Antonio Weather Bureau, who discussed "Severe Storm Search." He explained the methods used in forecasting severe thunderstorms and tornadoes, showing the Radiosonde, an instrument used for obtaining temperatures, humidity, wind direction and velocity up to 15 to 20 miles high, and how this data is used in connection with the surface weather chart. Included in Mr. McCrabb's discussion was a description of the Texas Radar Network and methods used in checking radar storm reports. In addition, two films of radar storm trackings were shown.

A series of recently released films on military and defense equipment and developments were shown to the chapter at its March 28th meeting.

The films were: "The Navy Terrier"—a self-guided missile tracking down its target; "The Bell X-2"—fastest thing in airplanes to date; "The Texas Towers"—newest link in the radar defense chain; "New Signal Developments"—the Signal Corps shows off its latest electronic devices; "The Nautilus"—the world's first atomic submarine; "The Super-Carrier Forrestal"—the largest carrier in the world, and "To the Ladies"—a complete tour of the newly dedicated WAC Center at Fort McClellan, Alabama.

Sixty-six members and guests attended the meeting at the Fourth Army Officers Club and the social hour and dinner which preceded.

Southern Connecticut

"Unique Applications of X-ray and Electron Tubes in the Medical Communications and Industrial Fields" was the subject of a presentation by H. Sherwood Cooke and Edward H. Gilbert of Machlett Laboratories, Inc., at the chapter's February 16th meeting in Bridgeport.

Mr. Cooke, manager of X-ray sales, briefly covered the history of Machlett Laboratories since the early days of gas filled X-ray tubes and described the improvements which have been made in tube design and construction. Rotating and stationary anode diag-

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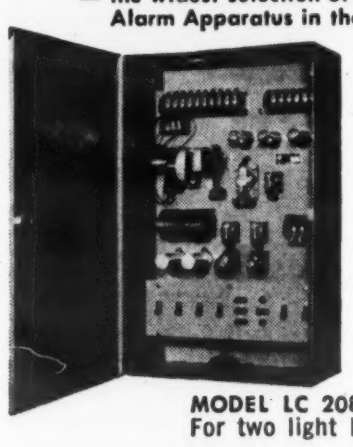

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U.S. Army Photograph

Electronic specialists at Ft. Monmouth SCEL Laboratories checking out radar and computing system designed for field use.

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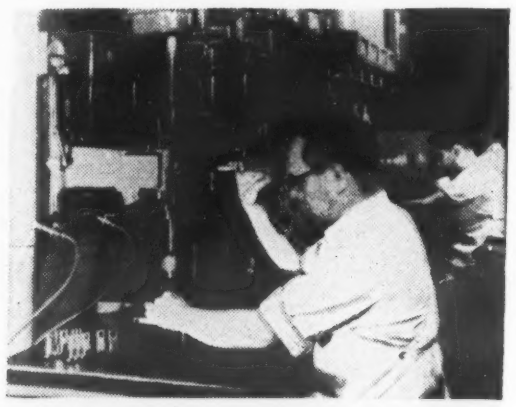

Skilled machinists at Ford Instrument Company, manufacturing precision parts for an Army military computer.

nostic tubes were displayed and discussed, as were forced oil cooked deep therapy tubes used in the treatment of various malignant diseases. Also displayed was the 24-million volt Betatron doughnut tube. Mr. Cooke explained that the primary problem in the design of an X-ray tube is dissipation of the heat generated by electron bombardment of the anode. He emphasized the importance of cleanliness and high vacuum in the art of tube making.

Mr. Gilbert, Eastern territory representative in Power Tube Sales, discussed some of the products in the plastics, wood, cloth and metal fields which are made better, faster and cheaper through the use of high power electron tubes in industrial radio frequency heating, and described how this type of heating worked. Three examples of high power electron tubes were displayed to demonstrate development from the older broadcasting type tubes to the modern ruggedized coaxial industrial types. High voltage industrial rectifiers and their applications were also covered.

Tinker-Oklahoma City

The Southwestern Bell Telephone Company, Oklahoma City, was host to fifty-one chapter members and guests on February 17th.

The speakers were: Carl Reeves, engineering staff, who presented an illustrated talk on "Manufacture of Transistors," and Al Turner, public relations department, who discussed "Telephone Magic."

A tour of the building included the toll dialing center and the television relay room.

During the business session, Jack W. Grewell, CAA, presented the following report on the progress of the chapter's school assistance program:

As an example of this type of chapter-sponsored activities, the USAF 6th Weather Squadron, Tinker AFB (Colonel Puson, commander), participated in a physics class at Del City High School directed by Mr. Jones, instructor. This included a 40-minute lecture (plus a 15-minute discussion period) on sources of weather information, methods of obtaining weather data, and use of physics fundamentals as applied to weather forecasting.

A description of radiosonde techniques was included as a prelude to observation of an actual radiosonde run. The radiosonde run can be observed as it is conducted on regular schedules at Tinker AFB. A mobile unit is available for conducting the demonstration at the school, if preferred.

Mr. Grewell further stated that teachers desiring this particular lecture and demonstration have been asked to schedule it near the conclusion of their class study unit on weather. Teachers whose requests can be accommodated are asked to furnish a copy of the textbook used in their course. School administrators are responsible for insuring that student discipline is satisfactory on all field trips.

He also pointed out that informed observers predict the present shortage of scientists, engineers and technicians available for the expanding electronics industry will become more acute unless positive remedial actions are taken to improve the present situation. He further stated that the Tinker-Oklahoma City Chapter project might well provide a dynamic motivating force for the chapter with considerable benefit to all concerned.

North Texas: Chapter officers elected at the March 26th meeting (l to r): John W. Williams, secretary-treasurer; Lt. Col. Randolph H. Vinding, president, and Capt. John H. Warburton, vice-president.

Headquarters of Oklahoma City Air Materiel Area (OCAMA) was host to the chapter on April 6th, with members of the staff conducting the evening's program. Mr. Matlock of the Comptroller's office explained the OCAMA mission and its place in the overall Zone of Interior and overseas Defense Department. Mr. Moody of the Electronic Data Processing Branch described the IBM 702 machine and explained its use.

The meeting was then adjourned and the 75 members and guests were taken on a tour of the OCAMA shops and the IBM 702 machine room. Thirty-five of the guests were members of the local unit of the American Institute of Electrical Engineering.

Tokyo

• The first general meeting of the new year was held on February 9th at the Golden Dragon Open Mess in Yoko-

Scott-St. Louis: Newly-elected officers and directors shown at the April meeting. Seated (l to r): A. Lisle Lenny, director; Robert E. Melling, vice president; Elmer J. Weber, vice president; Walter W. Van Skiver, president; Harry L. Cooper, past president; Prosper L. Kinsella, treasurer; B. Roger Robards, director. Standing (l to r): Lt. Col. Charles H. Colman, director; Louis E. Dechant, director; Michael A. Ebinger, director; Allan L. Eisenmayer, secretary; Lt. Col. John L. Jernigan, director, and Capt. James D. Porter, director. (Absent at time picture was taken were Lt. Col. William J. Trigg and James G. Blain, directors.)

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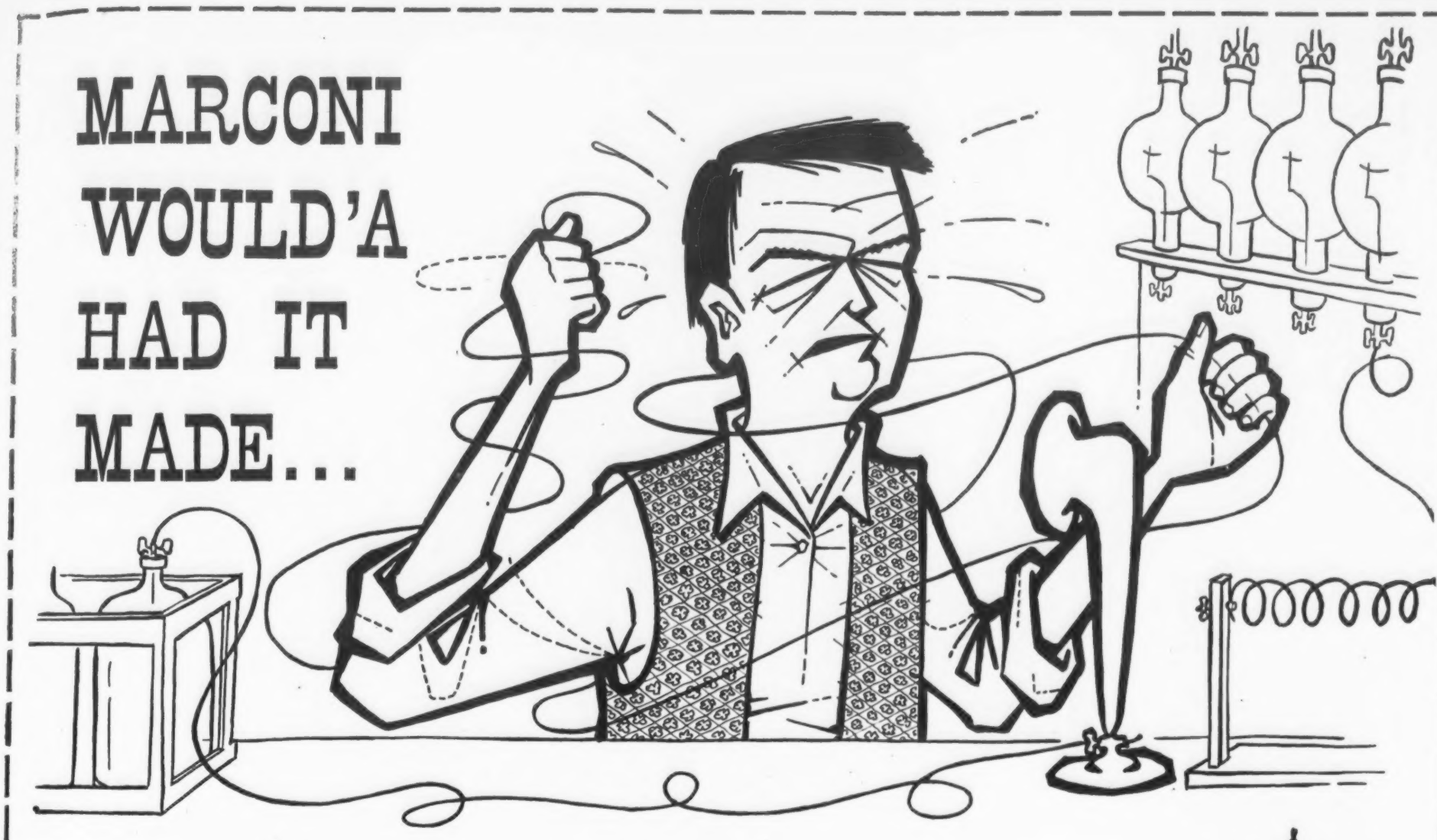

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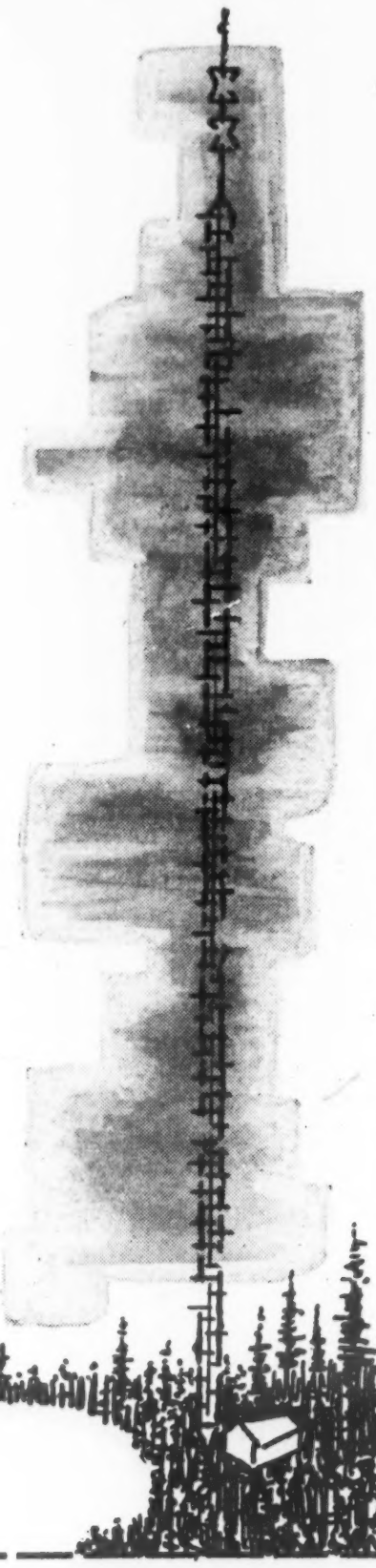

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CHAPTER NEWS

Tokyo: Pictured above are the executive officers of the chapter. Front row (l to r): Capt. Robert H. Weeks, vice president; Brig. Gen. Harold G. Hayes, vice president; Col. Philip A. Gugliotta, president; Col. Thew J. Ice, vice president; Frank E. Colonna, vice president, and Col. Carmon L. Clay, vice president. Back row (l to r): Lt. Col. Jeremy K. Schloss, program chairman; Capt. Thomas C. Musgrave, treasurer; James T. Ramsey, industrial representative; Charles F. Krause, secretary, and James J. Greene, publicity chairman.

hama with the Army acting as host to the 172 members and guests.

Maj. Gen. Albert Pierson, Chief of Staff, AFFE/8th Army, was the guest speaker and gave an outstanding address on the importance of communications to a field commander. His address was so well received by those in attendance, and was the source of so much favorable comment by civilian members and guests as well as by members and guests of all three services, that excerpts from it will appear in the next issue of SIGNAL.

Several tours of Army installations were conducted at the close of the meeting.

The first social event of the year was a cocktail party on March 16th at the Dai Iti Hotel in Tokyo. Music was furnished by the "Shamrock Four" and many members and guests stayed on for dinner and dancing.

Washington

"Communications for the Atomic Age Navy" was the theme of the March 1st luncheon meeting, with RAdm. Henry C. Bruton, Director of Naval Communications, as the distinguished speaker.

Plans to meet the increasing requirements of the "atomic age Navy" include a new VLF transmitting station in Maine which may exceed in power output the transmitter at Jim Creek, Washington, and development of the use of single sideband radio teletypewriter techniques in lieu of the medium and high frequency double sideband CW systems now employed for ship to shore traffic, Admiral Bruton reported. He also stated the Navy recently adopted a policy that all future procurement of medium and high frequency communications equipment must have a single sideband capability, and the Navy plans to introduce some single sideband equipment in the fleet during 1956.

Admiral Bruton told of the Navy's plan to adopt automatic switching at its principal relay centers within the continental United States, and said that at a later date it is expected that automatic switching equipment will be installed at some overseas centers.

Excerpts of the address appear under "Quotes in Review" on page 58.

A description of the Marine Corps, amphibious radio communications and electronics requirements was given at the April 5th luncheon meeting by Maj. Gen. Edward W. Snedeker, USMC, Assistant Chief of Staff G-3-Headquarters, USMC.

"Telecommunications Reports" reported the talk as follows:

"While great strides have been and are being made in research, design and development of the communications-electronics equipment for the Marine Corps' amphibious operations of the future, these advances have practically caught up with the Corps' past requirements and the new requirements 'present the same old challenge to the electronic industry of more reliable, rapid, jam-proof communications with less power, weight, size and antenna.'

"Future amphibious operations with atomic weapons in offensive action and defensive measures against enemy use, in exploiting the new Navy with its fast carrier task forces and teamwork of the Marine air-ground landing forces and the tactical mobility of the helicopter, General Snedeker said, 'will place more difficult requirements on radio communications and electronics than in past operations, and very few past operations have been satisfactory in this respect.'

"General Snedeker outlined major problems in this primary reliance on radio. These included the overcrowded spectrum, with the Marine Corps planning to move out of 2-100 mc by sponsoring development of radio relay equipment in the 5000 mc range, and investigation and development in electronic countermeasures."

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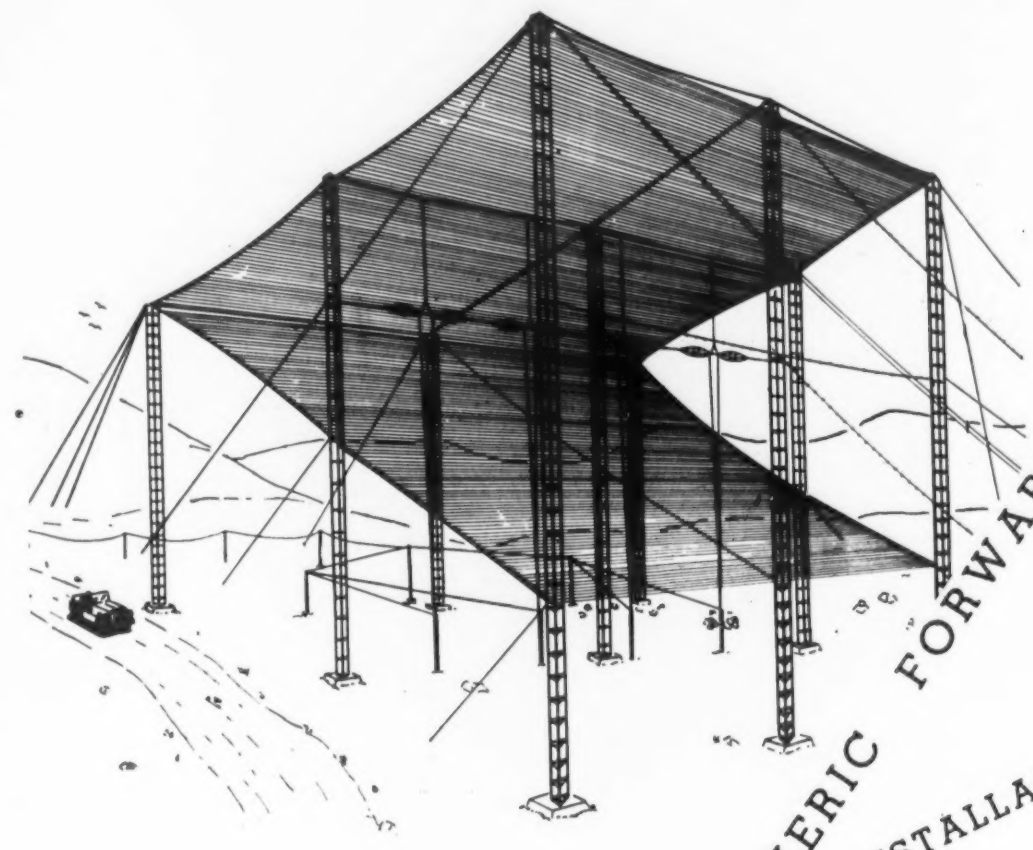

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ITEMS OF INTEREST

From Government, Industry and the Services

ARMY MISSILE MASTER

Missile Master, the country's first electronic system specifically for controlling and coordinating the use of NIKE antiaircraft missile batteries and other advanced Army weapons as they become available, has been developed by the Army with the Glenn L. Martin Company as principal contractor.

Systems being built by Martin will be located at key antiaircraft installations in the United States. Each system operates independently and can also operate in conjuction with units of the recently announced Air Force Semi-Automatic Ground Environment area defense system known as SAGE.

The system collects information on the location of aircraft and their identity, presents this information on electronic displays and distributes it to the missile firing batteries. In this way, each NIKE battery receives a continuous flow of fresh data on all aircraft within the defense area, and on the activities of the other batteries as well. Thus, each battery commander is provided with all the data needed to enable him to make a proper selection of a target.

In addition, Missile Master operators observe the activities of all batteries in the system, and where necessary, are able to direct a specific fire unit to a particular target, or to prevent friendly aircraft from being fired upon by our own weapons.

Each Missile Master system is housed in a large two-story building. Focal point is the operations center within this building where Army personnel at radar-type display consoles have a view of the over-all air situation in the local area as well as information on activities of the NIKE batteries under their jurisdiction. Surveillance and height-finding radar on towers, able to provide independent search and surveillance facilities, are installed adjacent to the building.

Key personnel of the system are: the tracking operators, who monitor early warning information as it enters into the Missile Master system; tactical controllers who evaluate the progress of an engagement and assign specific targets to batteries as may be necessary; the "friendly protector," who insures that NIKE batteries do not fire on known friendly aircraft; and the battery commanders, able to select or receive target assignments without conflicting with or duplicating the actions of other batteries.

Missile Master combines reliability and flexibility to an unusual degree. Critical elements of the system are provided in duplicate, so that either can carry the load. Operations can continue, however, even with one or more items inoperative.

Aiding the Glenn L. Martin Company in this project are the Airborne Instruments Laboratory of Mineola, Long Island, New York, and the American Machine and Foundry Company, New York, New York.

Electronic consoles, similar to these entry consoles in the system at Fort George G. Meade, Md., are the heart of the Missile Master system, developed for the Army by the Glenn L. Martin Co. Here, operators use photo-electric light guns placed against the screens to enter targets into the electronic tracking system.

Navigation System Tested for Flight-Position Picture

All-weather flight-position pictures from a radiowave "grid" system are being tested for aircraft, sea-going vessels and mobile ground units.

Being tested in southeastern Arizona by the Signal Corps, the Decca Navigation System was developed in England during World War II. The system now gives unbroken navigational coverage and traffic control in an area 1,500 miles long across Europe, from Northern Sweden to Spain.

Adapted by the Bendix Aviation Corporation, the system transmits its low-frequency radio waves as a continuous chain from a main transmitter and its slave stations, spaced 70 to 100 miles apart. The radio waves form a precise grid pattern ranging from sea level to extreme altitude. Each chain covers an area of approximately 175,000 square miles.

Evaluation data determining the system's applicability will be made available to the commercial airline industries, helicopter service industries and marine shippers through the Department of Commerce.

N.E. SHOW DRAWS 7,000 VIEWERS

A four-day display of over 100 exhibits featuring the latest technological advances developed by industry, Government, military, and private research laboratories was held March 26-29 in Boston, Mass.

Called the New England New Products, New Methods and Patents Exhibit, this effort was sponsored locally by both private and public organizations in the six states, under the honorary sponsorship of all the governors and with the cooperation of the U. S. Department of Defense (Army, Navy, and Air Force) and the Department of Commerce. The

(*Continued on page* 112)

ELECTRONIC SYSTEMS ENGINEERS and SCIENTISTS in

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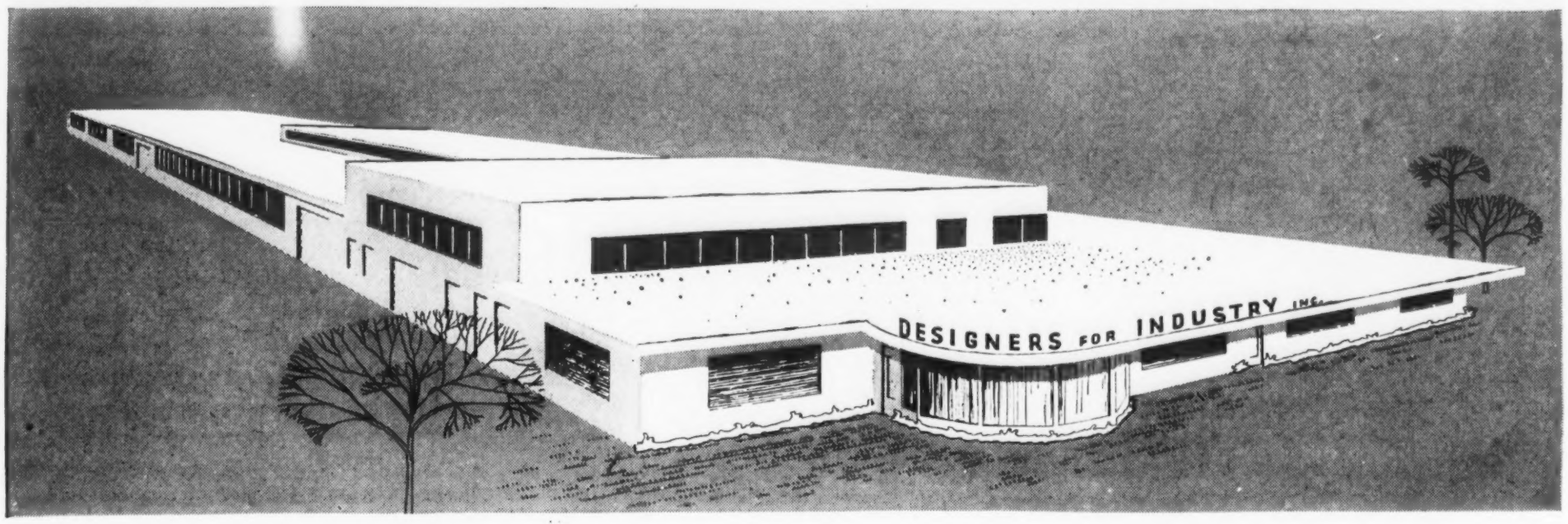

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professional freedom, mutual trust, challenging work and a dynamic, growing organization are combined into the proper atmosphere for stimulating creative development.

If you are interested write — all information will be treated in complete confidence — to James E. Burnett, Vice President, giving pertinent professional information.

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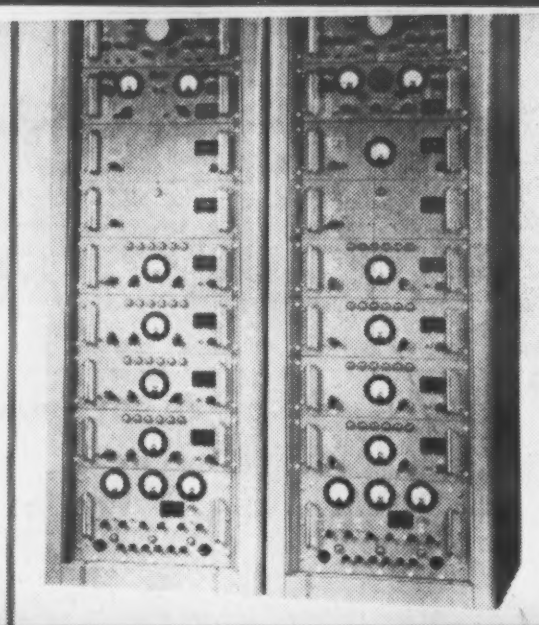
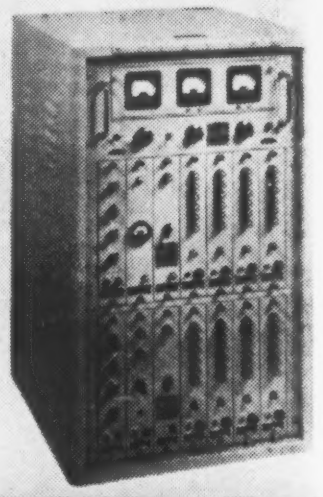
Comparison Data

- Telegraph Terminal Sets





	ELECTRONIC MULTIPLEX AN/FGC-5	TRANSISTORIZED MULTIPLEX AN/UGC-1 (XN-1)
Volume	55 CU. FT.	10.9 CU. FT.
Weight	1450 LBS.	275 LBS.
Power Input	1400 WATTS	75 WATTS
Transistors	0	572
Tubes	357	0
Germanium Diodes	33	739

Pictured above are the old and new teletype telegraph terminal sets.

Department of Commerce acted as coordinator for all Federal Government participation. Mr. Walter V. Robinson, Assistant Commissioner of the Massachusetts Department of Commerce, was chairman of the program.

The exhibits included displays from the fields of atomic energy, electronics, paper, plastics, textiles, metals, rubber, laminates, and process control handling.

Featured speakers at a Governors' Dinner honoring the exhibitors were the Hon. Walter Williams, Under Secretary of Commerce, and Maj. Gen. Henry R. Westphalinger, USA, Director of Procurement, Office of the Deputy Chief of Staff for Logistics. For excerpts from Mr. Williams' speech, see "Quotes in Review."

The exhibit was held as a part of the program of the Office of Area Development of the Commerce Department to aid certain areas of the country, suffering unemployment, with new ideas for local manufacturers. The success of this exhibit indicates that it will become a biennial event.

TRANSISTORIZED HIGH SPEED TELEGRAPH DEMONSTRATED

The first showing of a new high speed telegraph transmitter-receiver set using transistors in place of vacuum tubes was conducted recently by the Navy Bureau of Ships.

The demonstration was held in the Washington, D.C. office of the Teletype Corporation, developers and builders of the equipment for the Bureau of Ships.

This new set is 80% smaller and 82% lighter than the set it is designed to replace. It provides the same fuctions as the present equipment and may be used interchangeably with it. These functions consist of sending and receiving four telegraph channels simultaneously at 60 or 75 words per minute, depending upon traffic requirements and

Shown at the opening of the New England New Products, New Methods and Patents Exhibit held in Boston, Massachusetts, are (l to r) Gov. Lane Dwinell of New Hampshire; Maj. Gen. Raymond C. Maude, USAF, Commander, Air Force Cambridge Research Center; Gov. Joseph B. Johnson of Vermont; Vice Adm. Edward W. Clexton, USN, Chief of Naval Material; Mr. Carl F. Oechsle, Deputy Assistant Secretary of Commerce for Domestic Affairs; Mr. Walter Williams, Under Secretary of Commerce; Mr. Frederick H. Mueller, Assistant Secretary of Commerce for Domestic Affairs; Gov. Edmund S. Muskie of Maine; Maj. Gen. Henry R. Westphalinger, USA, Director of Procurement, Deputy Chief of Staff/Logistics, and Gov. Christian A. Herter of Massachusetts.

radio signal conditions.

The transistorized equipment, known as the AN/UCC-1, has the additional capability of handling 100 words per minute over each of four channels simultaneously. It is also anticipated that it will offer comparatively trouble-free maintenance, with as much as 10,000 hours of maintenance-free operation being possible.

This set is designed for use in both shipboard and shore installations. Its smaller size (10.9 cubic feet) and weight (275 pounds) make it suitable for use in small vessels and vehicles where the use of such a system has not previously been possible.

Charactron, the "Electronic Blackboard" of Defense

Serving as a unique "electronic blackboard," the Charactron tube manufactured by Stromberg-Carlson is a key component of the new air defense system known as SAGE (Semi Automatic Ground Environment).

SAGE, with the aid of the Charactron, can pick up the movements of any number of enemy bomber flights, determine their strength, type of plane being used, altitude, location and direction, and flash all that information on the screen of the tube in a matter of seconds. With the use of an overlay map, the entire maneuver of enemy planes can be watched on the screen.

The 19-inch Charactron is somewhat similar to a television viewing tube. If enemy planes are spotted by radar, the information is fed into a digital computer and then into the Charactron's shaped-beam tube.

Inside the complex electron gun is mounted a tiny disc perforated with letters, numerals and characters, each no longer than 12/1000ths of an inch. A combination of the small characters is enlarged and displayed on the tube screen, giving complete data on the planes. From there it is only a matter of assigning the needed defensive planes and other weapons to meet the enemy threat.

Vickers Auto-Pilot to Control Project VANGUARD Flight

The flight of the Project VANGUARD launching vehicle will be controlled by a magnetic amplifier auto-pilot unit to be designed and manufactured by the Electric Division of Vickers, Inc. of St. Louis, Mo.

Project VANGUARD is the program for a man-made instrumented satellite to be launched during the Inter-

(*Continued on page* 114)

meets the challenge of the guided missile age

Now, as through the years, Radio Receptor, a leading contractor to the Armed Forces and Industry for almost 35 years, contributes heavily to America's conquest of the skies . . . by designing . . . and producing a wide range of radio aids to navigation for both piloted and unmanned aircraft.

To this field, Radio Receptor has introduced such developments as the AN/CRN-11 Air Transportable Radio Range; the first airborne and ground VHF equipment used by CAA; omnidirectional radio range systems in low and medium frequencies with associated airborne receivers . . . and the BC-446 transmitter which was the corner-stone of radio range navigation for AACS. The recent S-Band Missile Beacon illustrated and briefly described below is another example of the dynamic role Radio Receptor plays in the national defense.

One of RRco.'s latest projects is the design, development and manufacture of the subminiature S-Band Missile Beacon for the Army. This transistorized unit 6" long by 2½" in diameter provides communication facilities which permit tracking and guidance of the missile in flight.

Engineering Products Division

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national Geophysical Year as a part of the United States' participation in this scientific program. The three-stage rocket will attempt to place the world's first man-made earth satellite in its orbit.

The magnetic amplifier auto-pilot unit will control the flight of the Vanguard vehicle from its launching point on Florida's East Coast to an altitude of approximately 300 miles above the earth.

Taking its flight instructions from the gyro-reference system, the unit will keep the vehicle on its predetermined flight course by moving the rocket engine, mounted on a gimbal—a kind of universal joint—so that the thrust of the engine will push the entire vehicle in the desired direction.

Similar in function to the electronic or radio vacuum tube, the magnetic amplifier is designed with high-grade electrical steels and intricate circuits for ruggedness and shock resistance.

Longer Runways Monitored By Television System

A closed circuit television system has extended the field of vision of the airport control tower operator. Kay Lab developed the remotely-controlled system for airport traffic control at the Naval Air Station, Alameda, California.

Lengthening of the station's runways for speedier propeller and jet aircraft prevented view of the landing and take-off strip from the control tower. Thus three television cameras were installed to adequately cover the approach of aircraft to the runway, the taxi path after landing and the vehicular traffic along the road.

All three cameras are capable of being remotely controlled to follow aircraft in flight or on the ground and vehicles on the road. Pictures are then relayed by coaxial cable to three monitors located at the tower control center. Objects as small as 0.1-inch high on the television monitor are visible. Small aircraft are visible at distances up to 10,000 feet.

A three-lens turret system enables the operator to select any one of three lenses at will and to focus the camera for that lens. Under predawn and dusk lighting conditions, these lenses allow a much wider variation in field of view at higher lens speeds than conventional zoom or telephoto lenses.

The camera is seated in a special weatherproof housing containing heaters and a cooling system thermostatically controlled for all-weather operation.

The housing is equipped with windshield wipers for wet weather and a K2 filter which can be lowered in place in front of the camera lenses under haze conditions. An automatic iris adjusts itself.

Watching an approaching plane on one of the three TV monitors in the tower control center at Alameda Naval Air Station are Cdr. Robert Corlett, USN, Operations Officer (left) and Cdr. William M. Heaman, USN, Public Works Officer. Looking on is R. T. Silberman, vice president and sales manager of Kay Lab, San Diego, developer of the monitoring system.

IRC Merges With Subsidiaries

International Resistance Company of Philadelphia, has announced its merger with three of its wholly-owned subsidiary companies—Hycor Company, Inc., Hycor Sales Company of California, and Ircal Industries.

All three facilities have been transferred to a new plant in Sylmar, Los Angeles County, California, and will be operated under the name of Hycor Division of International Resistance Company.

Hycor Division of IRC manufactures encapsulated precision wire wound resistors, decade inductors, toroid coils, reactors, wave filters, audio equipment, transformers and attenuators for the electronics industry.

New Transistor Production Technique

A new transistor manufacturing technique has been announced by Texas Instruments Incorporated of Dallas, Texas. A new "grown-diffused" technique working with either germanium or silicon has resulted in commercially available kernel-sized production transistors. Electrical signals can be amplified at usable power levels to over 100 megacycles and will oscillate to over 250 megacycles per second.

The new transistors will make available transistorized portable television sets and all-wave long distance radio receivers—with no power cord. Increased transistorization of plane and guided missile radar, communications, and navigational equipment is now possible.

The method of making transistors relies on precise control of tempera-

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ture and other factors. The new technique is based on the principles of solid state diffusion, wherein an ultra-thin base layer (analagous to the vacuum tube grid) is produced by the migration of added impurity atoms while the semiconductor crystal is being grown.

Silicon transistors now in production by this new process have gains of 15 db at 12.5 megacycles and 14 db at 30 megacycles with useful power levels up to 150°C. Silicon transistors are especially suited for use in guided missiles, supersonic aircraft, complex computers, and other critical applications where high temperatures are encountered.

A "grown-diffused" germanium transistor with a power gain of 10 decibels minimum at 100 megacycles and with a collector dissipation of 25 milliwatts at 75° Centigrade is also in production. Frequency cutoff is 200 megacycles.

A Marine Weather Station Radios Weather Data

Local weather data can now be automatically reported by radio from a prototype marine weather station developed by the National Bureau of Standards for the Navy Bureau of Aeronautics. Incorporated in a buoy, the unit can be anchored in remote locations and left for periods up to six months.

At regular intervals throughout the day, the station broadcasts in code the air temperature, water temperature, barometric pressure and wind speed and direction. Tests place the station's radio range in excess of 800 miles.

Translating information from five weather sensing elements into three-letter groups in continental code, the automatic station transmits the coded signals on a pulse-modulated carrier frequency at about 6 megacycles. These signals can be received on standard communications receivers and compared with a decoding table.

In a three minute interval, a single transmission broadcasts six items of information. A three-letter signal identifies the station, then coded transmissions follow relaying information on air temperature between —25° and +110°F, water tempera-

(*Continued on page* 116)

This ocean-based weather station developed by the National Bureau of Standards automatically reports local weather data by radio. The unit is built on a buoy that can be anchored in remote locations and left unattended for periods up to six months.

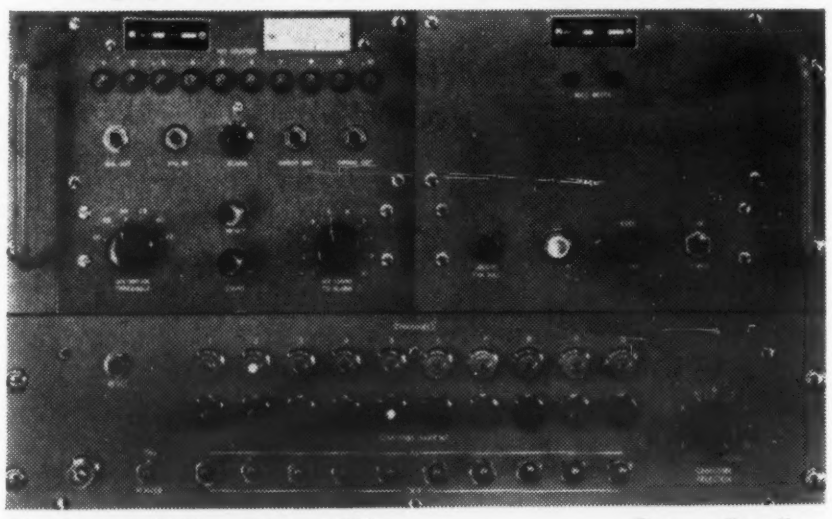
A New STELMA Development . . .

MULTICHANNEL TELEGRAPH MONITOR ASSEMBLY

a complete assembly for monitoring up to ten telegraph circuits automatically

Provides ***immediate warning*** when circuits ***begin*** to deteriorate!

Telegraph Monitor TM-1 Power Control Unit MPS-1



Monitor Switching Unit MSU-1 Patent Pending
(Overall panel size of assembly — 12 1/4" high x 19" wide.)

The STELMA Multichannel Telegraph Monitor Assembly is a totally self-contained automatic system that furnishes a ***warning alarm*** and ***alerts operating personnel*** when telegraph circuits are deteriorating to a degree that requires attention.

Monitor as many as ten telegraph channels in automatic sequence.
Increase the service on your wire and radio telegraph channels appreciably
at a ***remarkably low price per circuit.***

Your inquiry for complete technical information will receive our prompt consideration.
You are cordially invited to attend our exhibit at Booth 28 in the AFCEA Show.

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190 Henry Street • Stamford, Connecticut

STELMA communications equipment is used throughout the U. S. military services: telegraph distortion analyzer TDA-2; regenerative repeaters; electronic relays; bias test sets; D. C. telegraph repeaters; tone keyers, transistorized.

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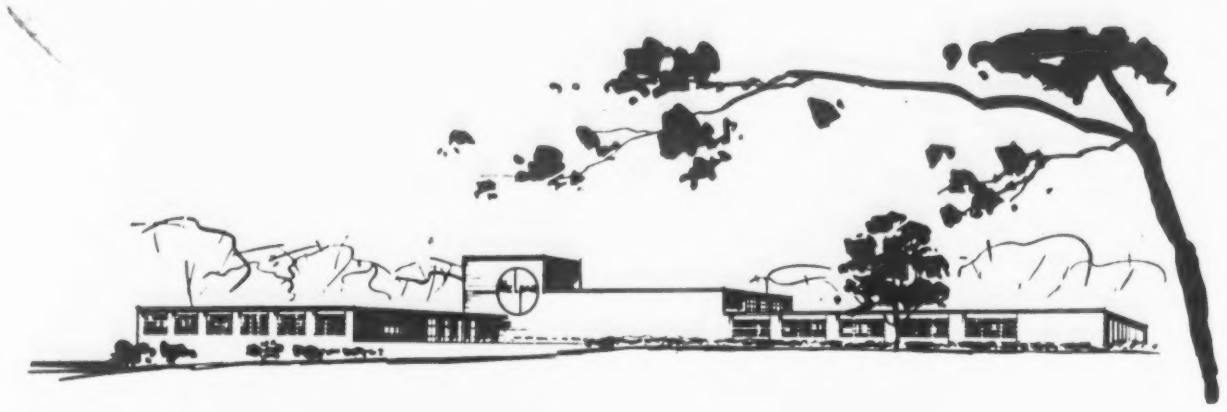

Top Grade Openings At Melpar *Leader in*

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Due to our continuing expansion program, a number of top grade openings exist in our new laboratories suburban to Washington, D.C. We urge you to consider the following:

1. At Melpar the engineer is not tied to a pre-arranged schedule of advancement. Instead, promotion and advancement are based on *individual recognition*, where skill and ability are the paramount factors of determination.

2. Melpar has doubled in size every 18 months for the past 10 years. New openings occur constantly. This enables the engineer to advance to positions of increased responsibility *as soon as he is ready.*

3. Our unique "project team" basis of organization gives the engineer an opportunity to participate in *entire* problems from conception to completion of prototype, and thus experience the "over-all" approach to engineering problems necessary to eventual directorship responsibility.

4. Our new air-conditioned laboratories encompass over 285,000 square feet and offer *complete* facilities for creative research and design. In addition to our central Model Shop, supplementary facilities, personnel and test equipment are available for *immediate* use within each project group.

5. The Northern Virginia Area, suburban to Washington, D.C., in which Melpar is located, offers excellent living conditions, enjoys the Nation's highest per capita income, fine homes and schools. Recreational, cultural and educational facilities abound. Fully-accredited graduate courses are offered at the Melpar laboratories and at 5 universities in the Area.

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Network Theory • Systems Evaluation • Microwave Technique • UHF, VHF, or SHF Receivers • Analog Computers • Magnetic Tape Handling • Digital Computers • Radar and Countermeasures • Packaging Electronic Equipment • Pulse Circuitry • Microwave Filters • Flight Simulators • Servomechanisms • Subminiaturization • Electro-Mechanical Design • Small Mechanisms • Quality Control and Test Engineering.

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ITEMS OF INTEREST

ture between 15° and 90°F, barometric pressure between 950 and 1050 millibars, wind speed from 0 to 68 knots and wind direction oriented from magnetic north.

Sending speed can be controlled, and a rate of five to seven signal repetitions during the 20-second interval permits even inexperienced operators sufficient time to copy the signal. Altogether, the three-minute transmission period contains six transmission intervals of 20 seconds duration, each preceded by 10-second balancing intervals.

Primary power comes from 180 4FH dry cells connected in series-parallel to give 13.5 volts at 15 amperes. In future models of the boat stations, a gasoline-powered generator and storage battery will replace the dry battery supply.

NRL Develops New Filter

A small active filter without precision components for use in the solution of certain electronic circuit problems has recently been developed by the Naval Research Laboratory.

In a report released to industry by the Department of Commerce, the Navy states that the filter has been developed with a passband width of 0.01 cps. It is reported that its self-tuning range, hold-in range and space requirement cannot be equalled by conventional passive filters.

The report, PB 111787 "An Active Filter," is available for 50 cents from the Office of Technical Services, Department of Commerce, Washington 25, D. C.

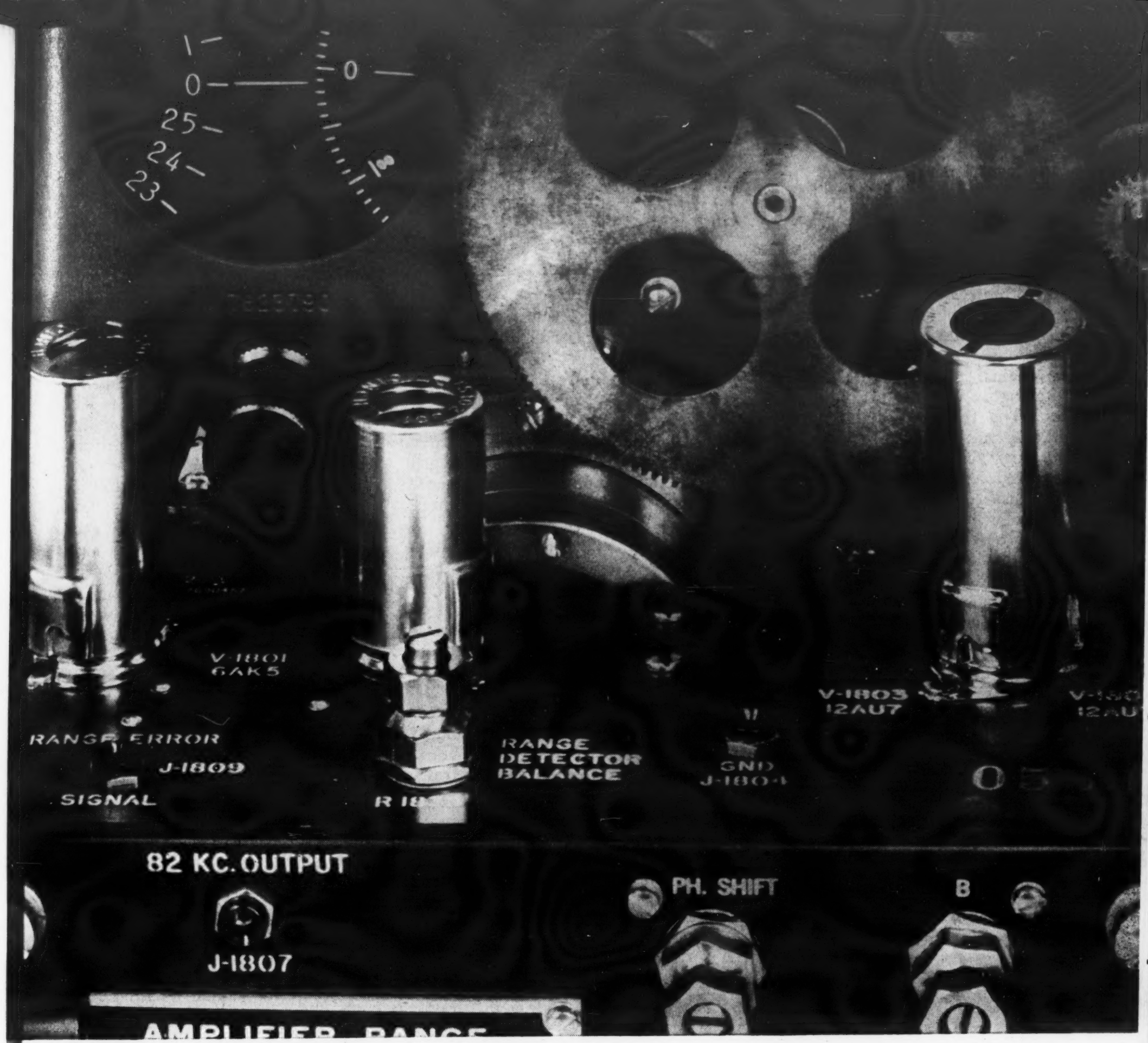
Low Power TV For Small Communities

New low-power television broadcasting "packages" developed by Philco Corp. can now meet the needs of an estimated 800 small communities. High cost of conventional equipment up to now has made television unavailable in many areas.

The value of low-power television equipment has been proven by the Armed Forces which have used it for information and educational stations, and for battlefield surveillance.

The package includes a transmitter, monitoring equipment, high-gain antenna and transmission line, and local program originating facilities for transmission of slides, films and local live shows. Outside plant items such as studio transmitter building and tower are also available.

(*Continued on page* 118)



Electronic equipment built by Delco Radio for T-38 SkySweeper

SKYSWEEPER... from Delco Radio

Delco Radio has an unparalleled record of high-quality, low-cost mass production, in peace and war. That's because of unique integrated production facilities. Delco Radio can produce finished products *from raw materials* for less than ordinary assembly contractors. Centralized production also results in tighter quality control and on-time delivery. When you need high-quality units at lower cost, take advantage of Delco Radio's experienced engineering and production facilities.

GM GENERAL MOTORS

DELCO RADIO
DIVISION OF GENERAL MOTORS
KOKOMO, INDIANA

ITEMS OF INTEREST

The equipment, which may be operated by one man, consists of a crystal control modulator unit which produces modulated, visual and aural television program carriers and an intermediate amplifier of 20 watts power. The final power amplifier provides 150 watt peak visual power and 75 watt aural power output to the transmission line.

The program originating equipment consists of film and live camera chains, video monitoring and switching facilities, and audio facilities. The frequency band used in battleground surveillance—470 to 500 megacycles—can be covered by the transmission equipment.

Because most low-power television stations will want to pick up network programs from large, nearby cities, Philco is also offering high-quality microwave relay equipment with the package. Equipment can be used for monochrome and color television.

40,000 Engineers and Scientists Attend IRE Convention

Over 40,000 engineers and scientists converged upon the Waldorf Astoria and the Kingsbridge Armory in New York for the four-day national convention of the Institute of Radio Engineers.

Despite the heavy snow, a record number of electronics scientists and engineers examined the convention's exhibits representing about 80 per cent of the country's productive output in electronics. Electronic equipment valued in the millions formed two miles of exhibits in some 715 booths that filled the 4-acre floor of the Kingsbridge Armory.

The Institute's highest annual award, the medal of honor, was awarded to John V. L. Hogan, one of the Institute's three founders. Presented at the annual banquet by Institute president Arthur V. Loughren, the medal was given to Mr. Hogan in recognition of his long sequence of inventions in the communications art, notably facsimile.

The technical progam was highlighted by two special symposiums: one on The U. S. Earth Satellite Program," another on Color Television Tape Recording." Fifty-five technical sessions covered all the latest advances in the twenty-four fields of electronics. Some of the topics discussed were the impact of computers on science and society, nuclear effects on communication systems, the future of medical electronics, and air traffic control.

NEMS-CLARKE Special Purpose Receivers are designed for optimum performance in telemetering, guided-missile monitoring and radiosonde reception and many other applications calling for superior performance. These Receivers are now in use by most of the leading aircraft companies.

CONVAIR
SPECIFIES
NEMS-CLARKE
ALL-PURPOSE
RECEIVERS

Above photo shows portion of telemeter ground station test unit of Convair's Guided Missile Plant in Pomona, Cal., using the NEMS-CLARKE Receiver.

For further details
Write Dept. B-4

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Camera Developed With Automatic Exposure Control

A gun camera has now been designed which automatically compensates for changes in light conditions emulating the iris of the human eye. Designated the "KB-5," the camera was engineered by Fairchild Camera and Instrument Corporation of Syossett, N. Y.

These motion picture cameras, installed on super-sonic jet fighter planes, can be used to record details of aerial combat. When engaged in a "dog fight," the nose of the plane may be pointed at brilliant sunlight sky, and a few seconds later at a densely shaded area of the earth. The automatic exposure control adjusts to the variances in available light.

In the Fairchild KB-5 the actual illumination received through the picture-taking lens can be compared 64 times a second with the illumination from a reference lamp inside the camera. If there is a difference, the lens diaphragm is changed to match the light level of the reference lamp which insures proper film exposure. This is accomplished by a closed loop system, employing a transistor servo amplifier. The rate of response to a change in light is rapid. The system will drive 6 lens stops in 1.8 seconds.

Made up of a series of individually packaged components that are readily interchangeable, the camera, fully loaded with 50 feet of film, weighs less than 5½ pounds.

Helicop-Hut Tested by Air Force

A highly flexible and mobile shelter, which can be picked up and dropped by helicopter recently received its operational suitability tests at Langley Air Force Base, Virginia.

The structure is known as the "Helicop-Hut" and was utilized as a packaged 2,690-pound radio relay station in its Langley test. The manufacturer, Craig Systems of Danvers, Massachusetts, reports that it can be put to a hundred military or civilian uses—from photo lab to aid station.

Primarily advantages of the structure are its strength, light weight and capability of being transported by air to inaccessible locations. Constructed of aluminum with a bonded aluminum foam core, the shelter is designed so that lifting forces are evenly distributed.

This test at Langley AFB was part of an overall Tactical Air Command-Rome Air Development Center project known as "Wagon Wheels."

PERSONNEL CLEARING HOUSE

AFCEA Members Available to Industry

The pages of SIGNAL are open to active AFCEA members who are seeking positions in the communications, electronics and photographic industries. Any member is entitled to space free of charge in this column for three issues of the magazine. Please limit your notice to five lines. In replying, employers are asked to address: Box ....., SIGNAL, 1624 Eye Street, N. W., Washington 6, D. C. Letters will be forwarded to the AFCEA member.

FIELD REPRESENTATIVE OR EXECUTIVE ASSISTANT.. Over 20 years' experience in Defense Agency in top executive assignments, with experience in R & D, procurement and production administration. Working knowledge of R & D and procurement policies and procedures, and equipments. Box 118.

RESEARCH AND DEVELOPMENT ENGINEER—age 30, B.S. in E.E. and B.S. in Bus. Admin. Desires to relocate where part time graduate training in E.E. is available. Prefer communications field (microwave, carrier, telephone, etc.). Further particulars furnished on request. Box 119.

Government and Military Positions Available

Government and military agencies are invited to use this column to announce available positions which may be of interest to the readers of SIGNAL. Notices will be published three times if not cancelled before. Applicants apply as indicated in individual notices.

THE SPECIAL DEVICES CENTER, an activity of the Office of Naval Research, located at Sands Point, Port Washington, Long Island, has several vacancies for electronic engineers at $6390 a year, and one vacancy for a general engineer at $6390 a year which requires specialized experience in audio-visual recording. Inquiries should be directed to the Industrial Relations Officer. Telephones: Flushing 7-8300 and Port Washington 7-3800.

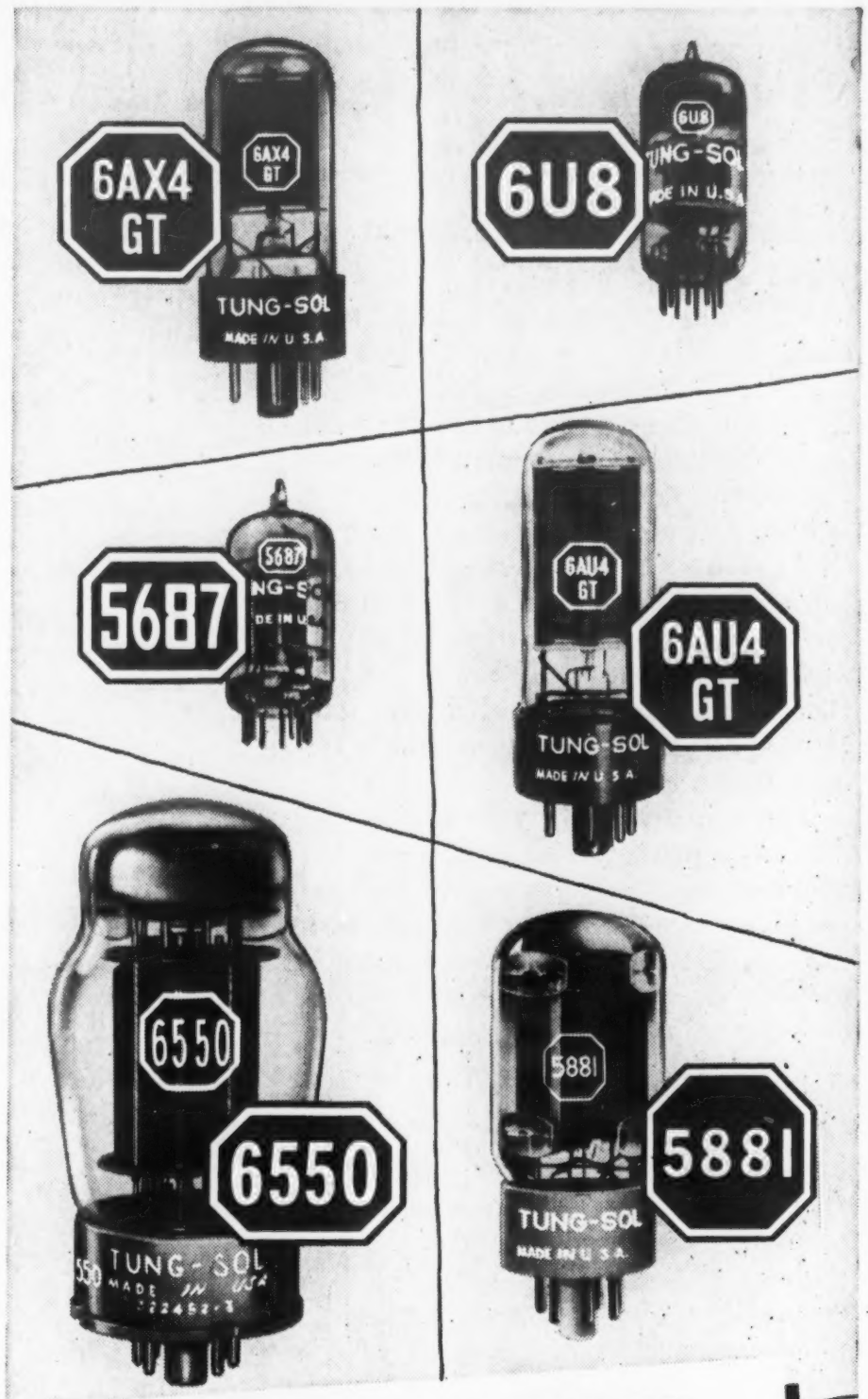
COMMUNICATIONS CODING CLERK (GS-4—$3,415/year). Applications are now being accepted by the U. S. Civil Service Commission for clerks with specialized experience in communications coding work. Applicants must have had at least one year of general clerical experience and one year of specialized experience, and are required to pass a written test. Apply to the U. S. Civil Service Commission, Washington 25, D. C.

ELECTRONIC SPECIALISTS are urgently needed at the Corps of Engineers Research and Development Laboratories, Ft. Belvoir, Va. Applicants must hold a degree in electrical engineering, physics or mathematics, or have considerable research experience in their fields. Salaries range from $4345 to $8940 per year, commensurate with education and experience. Apply to Walter H. Spinks, ERDL, Ft. Belvoir, Va.

RADIO OPERATOR TECHNICIANS. Veterans $3400-$4200 to start. Overseas opportunities. Amateur or commercial licenses helpful. Full pay during advance training. Good advancement opportunities. Submit resume with name, age, address, phone number—if any, military experience, private training, work experience, FCC licenses—if any. Armed Forces Communications and Electronics Association will forward same immediately to employer who will acknowledge your application direct.

TELETYPE OPERATORS AND CRYPTOGRAPHIC TECHNICIANS. Veterans $3200-$3700 to start. Overseas opportunities. Full pay during training period. Good advancement opportunities. Submit resume with name, age, address, phone number—if any, military experience, FCC licenses—if any. Armed Forces Communications and Electronics Association will forward same immediately to employer who will acknowledge your application direct.

THE UNITED STATES CIVIL SERVICE COMMISSION has announced examinations for Microphotographer, $2,960 to $3,670 a year, Photostat Operator and Blueprint Operator, $2,960 to $3,415 a year, and Photographer, $2,960 to $4,525 a year, for filling positions in various Federal agencies in Washington, D. C., and vicinity. Appropriate experience or training is required. No written test is required for Photographer positions, but for the other positions, a written test will be given. Further information and application forms may be obtained at many post offices throughout the country, or from the U. S. Civil Service Commission, Washington 25, D. C. Applications will be accepted by the Commission in Washington until further notice.



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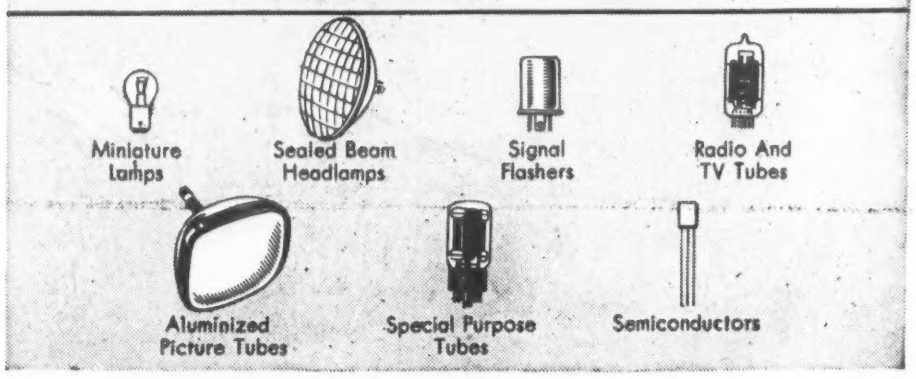


NEW PRODUCTS FROM INDUSTRY

RCA Precision Electronic Test Apparatus

RCA has entered the field of specialized laboratory test apparatus. These new instruments are built to facilitate the design, development and production of complex electronic equipment and systems.

The initial line includes thirteen instruments; a pulse generator, two types of radio frequency (RF) power meters, two types of null reading volt meters, a vacuum tube volt meter, two types of impedance bridges, four types of signal generators and a deluxe multimeter.

These instruments with their high degree of precision measurement and accuracy will be effectively used on complex electronic equipment such as radar, computers, fire-control systems, radio and television receivers and communications equipment.

Silver Zinc Battery

Developed by American Machine & Foundry Company, 261 Madison Ave., New York, N. Y., a new type of battery can now be used for rocket and transistor applications. The low-cost silver zinc battery employs a pile-type construction instead of the conventional plate-type construction. Each cell is an individual battery.

Offering high discharge capabilities with flat discharge voltage characteristics, the new unit can be assembled to meet the voltage requirements of any application. A 28-volt battery designed for continuous discharge at 5 amperes, for example, would be approximately the size of a package of king-size cigarettes, weighing only seven ounces.

The battery is shipped dry and can be filled with electrolyte without special equipment. The dry shelf line is expected to be five years.

Control Thyratrons

The Tube Department of General Electric, Schenectady, N. Y., has brought out a new control thyratron with three base connections.

The three new types of this 6.4 ampere negative control characteristic thyratron—GL-6807, GL-6808, GL-6809—all incorporate element and envelope construction designed to provide cooling to eliminate causes of inoperation.

The GL-6807 has a pin-type base and can be used interchangeably with the GL-5545. The GL-6808 has flexible "flying" leads and the GL-6809 is made with spade lug terminals extending from the base.

They carry high commutation factor ratings particularly suited to motor control and other inductive load circuits without cushioning. Another feature is the ability to operate over a wide ambient temperature range (−55 to +70C).

Maximum average cathode current of these motor control thyratrons is 6.4 amperes and fault current 1120 amperes. Maximum negative control grid voltage before conduction is minus 250 volts and during conduction is minus 10 volts. Maximum positive control grid current is 0.20 amperes with the anode positive and 0.10 amperes with the anode negative.

Atomic Frequency Standard

The first commercially available atomic frequency standard, "Atomichron," has now been perfected by the National Company of Malden, Mass.

This "atomic clock" offers a stability of frequency of five parts per ten billion or more. As an elapsed-time measuring instrument, it is an accurate and stable calibrating instrument for oscillator crystals.

The Atomichron can provide a means of communications monitoring and control which permits the design of receivers and transmitters of such narrow and precise bandwidth that it can double utilization of the radio spectrum.

The self-monitoring system is based on the phenomenon that an uncharged cesium atom, when subjected to an R.F. field at 9192+mc is likely to change energy level. By multiplying the output of a 5 mc primary crystal frequency standard to the resonance frequency of cesium, then measuring the rate of changes in energy level of cesium atoms in the R.F. field, it is possible to monitor and correct the output of the 5 mc oscillator to an accuracy of 1 part in 10^9.

This same degree of accuracy and stability is achieved on all the output channels of the Atomichron: 100 kc, 1 mc, 5 mc, 10 mc, and 100 mc.

The "atomic clock," developed by the National Company of Malden, Mass., is the first commercially available atomic primary frequency standard. In electronic research and manufacturing, the standard may be piped to various places in the laboratories and assembly lines.

Ka-Band Rotary Joints

Microwave Associates of 22 Cummington St., Boston 15, Mass., announces the development of high power rotary joints for use with mechanical scanning antenna systems operating in the Ka-band spectrum (34.0-35.5 Kmc/s).

Models MA-1037A and MA-1037B rotary joints withstand pressures of 65 PSI absolute under continuous operating conditions. The MA-1037A is designed for antenna gear box installations in which the stationary portion of the rotary joints passes down through the center of the main shaft. The MA-1037B is designed for general applications.

All units contain a teflon all-weather seal which protects the interior of the circular and rectangular RG-96/U waveguide sections.

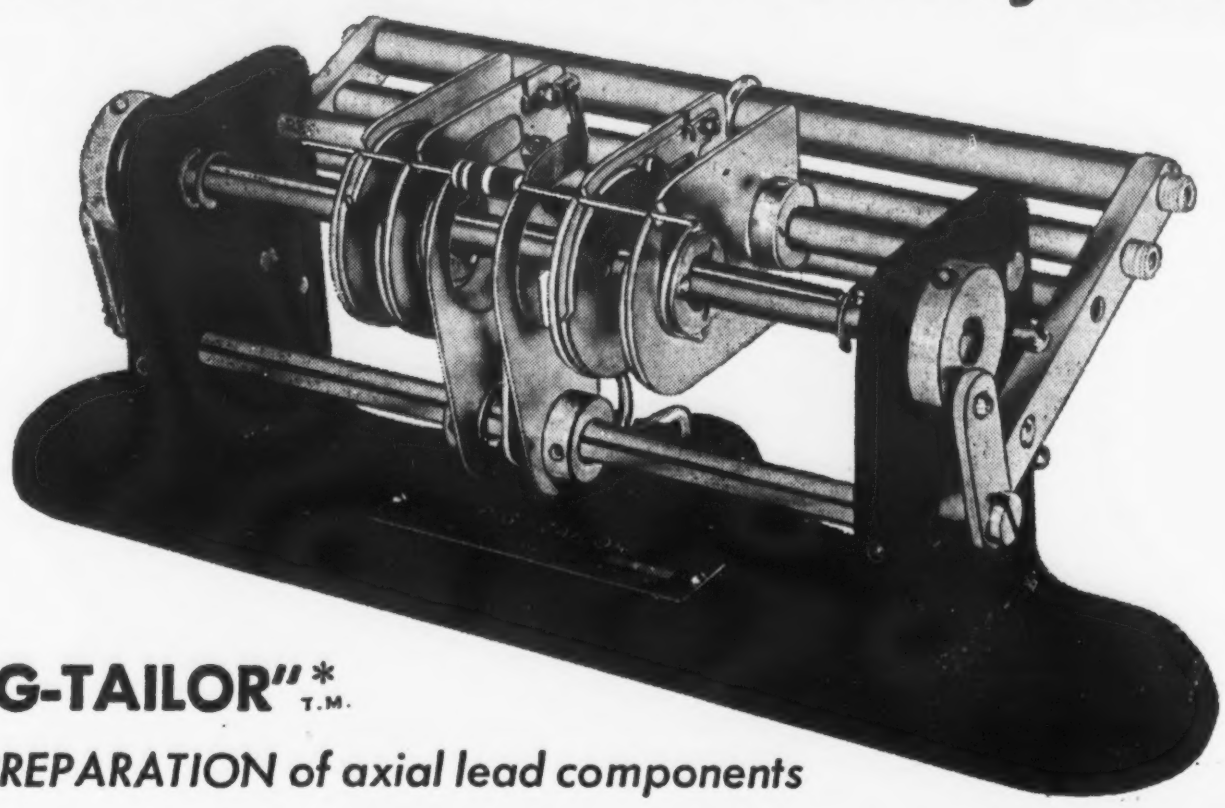
Sprague Electrolyte Capacitor

A tiny new electric capacitor has recently been developed by Sprague Electric Company, 97 Marshall St., North Adams, Mass. No larger than the head of a common kitchen match, the capacitor is only 1/8" in diameter by 1/4" long, but with an electrical storage capacity of 12 microfarads.

The hermetically-sealed solid elec-

(*Continued on page* 122)

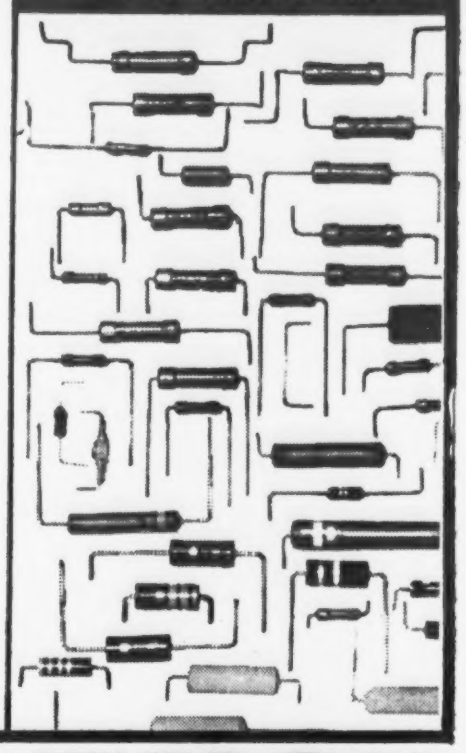
PROVEN-on the assembly line!



"PIG-TAILOR"* T.M.

For PREPARATION of axial lead components

PREPARED COMPONENTS IN SECONDS WITH THE "PIG-TAILOR"



"PIG-TAILORING"

. . . . a revolutionary new mechanical process for higher production at lower costs. Fastest PREPARATION and ASSEMBLY of Resistors, Capacitors, Diodes and all other axial lead components for TERMINAL BOARDS, PRINTED CIRCUITS and MINIATURIZED ASSEMBLIES.

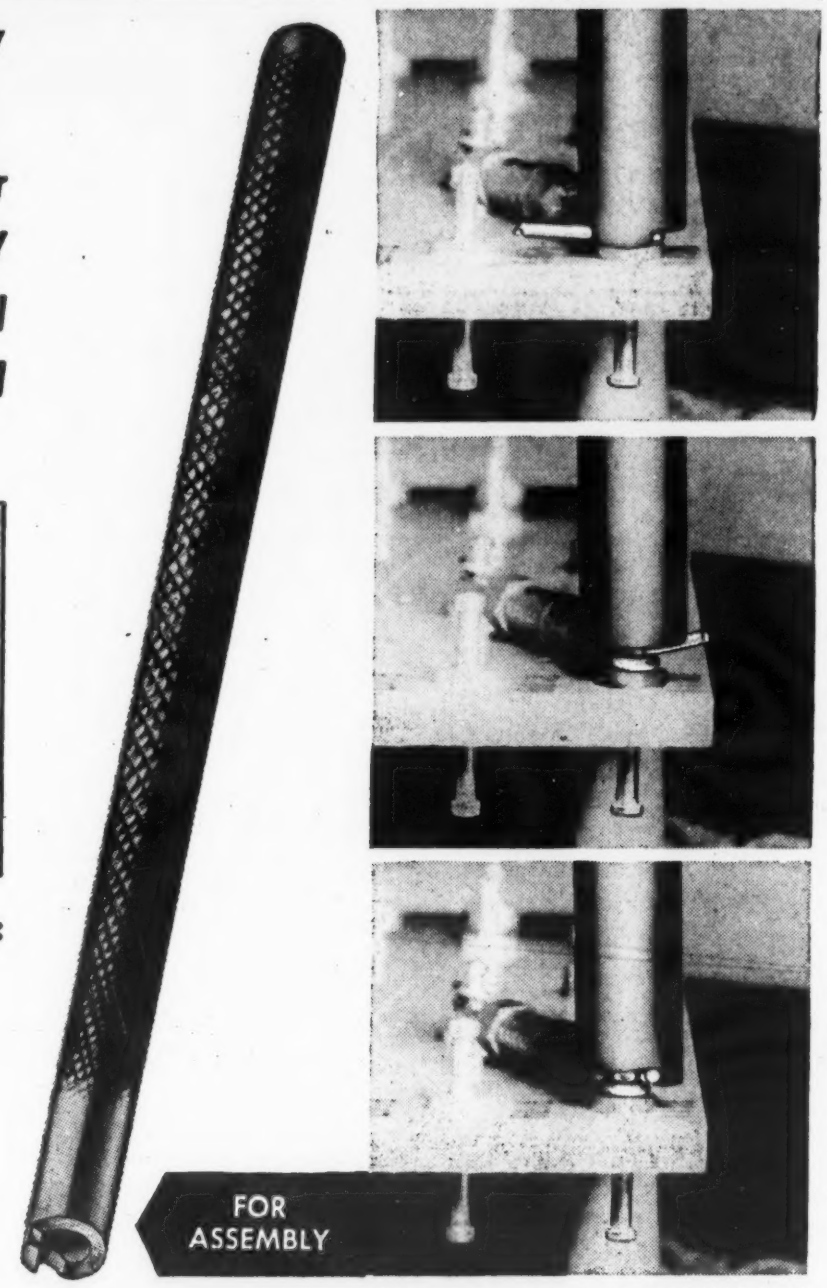
The "PIG-TAILOR" plus "SPIN-PIN"—accurately MEASURES, CUTS, BENDS, EJECTS & ASSEMBLES both leads simultaneously to individual lengths and shapes—3 minute set-up—No accessories—Foot operated—1 hour training time.

PIG-TAILORING provides:

1. Uniform component position.
2. Uniform marking exposure.
3. Miniaturization spacing control.
4. "S" leads for terminals.
5. "U" leads for printed circuits.
6. Individual cut and bend lengths.
7. Better time/rate analysis.
8. Closer cost control.
9. Invaluable labor saving.
10. Immediate cost recovery.

PIG-TAILORING eliminates:

1. Diagonal cutters!
2. Long-nose pliers!
3. Operator judgment!
4. 90% operator training time!
5. Broken components!
6. Broken leads!
7. Short circuits from clippings!
8. 65% chassis handling!
9. Excessive lead tautness!
10. Haphazard assembly methods!



"SPIN-PIN"* T.M. Close-up views of "SPIN-PIN" illustrate fast assembly of tailored-lead wire to terminal.

* PATENT PENDING

Write for illustrated, descriptive text on "PIG-TAILORING" to Dept. S 5P

BRUNO-NEW YORK INDUSTRIES CORPORATION

DESIGNERS AND MANUFACTURERS OF ELECTRONIC EQUIPMENT

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trolyte tantalum electrolytic capacitor is the first of its kind commercially available for use in transistorized electronic devices. Solid construction makes it capable of withstanding high shock. Complete hermetic sealing in a metal case with tiny glass-to metal solder-seals permits it to withstand humid atmospheric conditions.

PRECISION
OPTICS
Manufactured to closest tolerances... Large or small runs.
LENSES..
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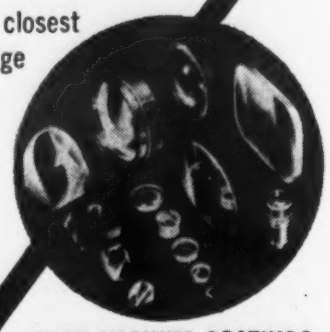

HIGH VACUUM COATINGS
Our engineering department is available for consultation. Send us your problem. Estimates promptly submitted.
ZENITH
OPTICAL LABORATORY
COPIAGUE, L. I., N. Y.

It changes in capacitance value by only 5% from room temperature over a range of —132 F to +185 F. Its resistance to change is important in airborne electronics, guidance, computer, navigation, radar equipment and missile electronics.

The new Sprague capacitor uses a spongy positive plate made of powdered tantalum metal by pressing it in a die and then heating it. The electrolyte with which it is impregnated is a solid semi-conducting material instead of a liquid acid or paste of strong salts.

Computer Power Supply

To meet the needs of a computer power source, Magnetic Research Corp. of 200 Center Street, El Segundo, California, has designed and engineered a dual magnetic regulated "Stablvolt" DC power supply.

These new units provide line-transient-free precision regulated DC output voltage for analog and digital computers where low ripple and dynamic and static regulation are required.

The dual magnetic system consists of two separate regulators. The first regulator is of the "internal" reference type and regulates line transients and line voltage change. The second regulator regulates against load change. The instantaneous magnetic line voltage regulator keeps the average value of the line voltage constant. Termed the Flux Oscillator it provides short circuit protection of the DC power supply.

The maximum short circuit varies between 120% and 200% of full DC load current. The line current flows continuously during the entire line half cycle. Power factor for power supply units is above 0.9 at full load.

Holtzer-Cabot Hand Generator

Guaranteed to last at least four times longer than previous models, a new hand generator has been introduced by the Holtzer-Cabot Telephone Equipment Division of National Pneumatic Co., Inc., 125 Armory St., Boston 19, Mass.

Designated "Mark VII," it is capable of withstanding a minimum of 200,000 operations. At 200 rpm, it produces 20 cycles AC at 1.75 watts, open circuit voltage of 95 volts minimum. It weighs less than 23 ounces and is mechanically and electrically interchangeable with other types of hand generators.

Seventh in a series built since World War II, the Mark VII features a special delay-type cut-in switch and non-cogging armature characteristics.

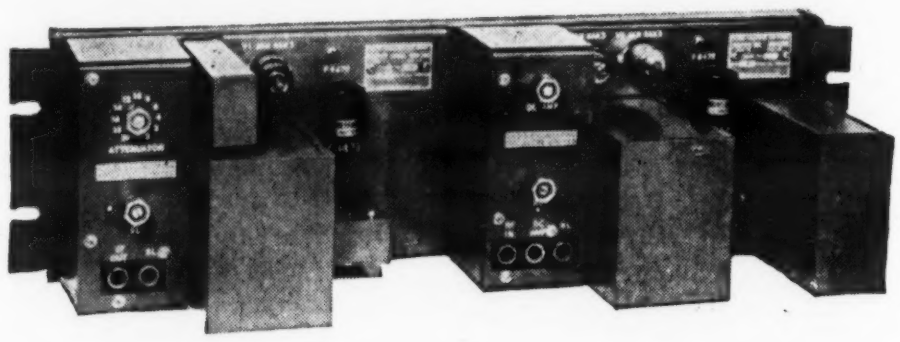
Trak Static Rejector

Improving the reliability of code communication, the Trak static rejector combines impulse-noise rejection with automatic tuning of the receiver to which it is connected. The unit has been introduced by CGS Laboratories, Inc., 391 Ludlow St., Stamford, Connecticut.

Since a code signal occupies only a narrow frequency band, while impulse noise covers a wide spectrum, the static rejector contains filters which analyze the receiver's audio output at the signal frequency and on each side of it. Noise signals in the sideband regions are subtracted from the center channel output leaving only the code signal to be copied.

Additional noise protection is furnished by an adjustable pulse-width discriminator which, when set to the appropriate words-per-minute rate, eliminates all impulses shorter in duration than one "dot." In addition, high amplitude noise pulses are clipped in special bi-stable trigger circuits.

An automatic frequency control

FREQUENCY-SHIFT V-F CARRIER-TELEGRAPH SYSTEM
Provides one, two, or three frequency-shift teletype channels above the voice on a 3400-cycle telephone circuit

A send and a receive panel require 5¼" of mounting space on a standard 19" rack
This system provides an economical trouble-free method of obtaining up to three full-duplex 100 wpm telegraph channels at the upper end of a broad-band telephone channel, and still retain a 2950-cycle voice circuit. Mid-channel carrier frequencies of 3120, 3240 and 3360 cycles are employed. The mark frequencies are 30 cycles below and the space frequencies are 30 cycles above the mid-band frequencies. The three telegraph channels are transmitted in the band 3080 to 3400 cycles, leaving the band below 2950 cycles for the voice channel.
Fault-free teletype circuits are obtained, even where the telephone circuit on which they are superimposed suffers from noise or abrupt level variations which may be so great as to render on-off keyed signals unintelligible. Frequency-shift signals do not suffer deterioration from non-linear transmission, such as is caused by overloading in voice-frequency, carrier or radio equipment. Under most circumstances a signal-to-noise ratio per channel as low as 20 db is satisfactory, and under some conditions even lower ratios result in fault-free operation. This equipment meets the requirements of current MIL specifications wherever applicable.
RADIO ENGINEERING PRODUCTS
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Telephone: UNiversity 6-6887 Cable Address: Radenpro, Montreal
MANUFACTURERS OF CARRIER-TELEGRAPH, CARRIER-TELEPHONE AND BROAD-BAND RADIO SYSTEMS
See us at Booth 38 in the AFCEA Show

system, operating a reversible motor drive on the receiver's tuning shaft, maintains accurate tuning in the presence of receiver drift, transmitter drift, or both.

A magnetic servo amplifier controls the tuning motor which can be disconnected instantly by means of a quick-acting clutch when manual tuning of the receiver is necessary.

A signal regenerator furnishes code signals of a pitch adjustable to suit operator preference to the output jack of the unit. A keyed DC output is also provided for the operation of ink recorders and similar equipment. A 3-inch cathode-ray tube display simplifies initial tuning and provides a continuous operating check on the system.

Sensitive Electrometer

A battery-operated DC vacuum-tube voltmeter has been developed by Keithley Instruments, Inc., 3868 Carnegie Ave., Cleveland, Ohio.

The new model has an input impedance of over 10^{14} ohms, a grid current less than 5 by 10^{14} ampere and full scale accuracy within 2 percent. The instrument has 8 voltage ranges of 0.008, 0.02, 0.08, 0.2, 0.8, 2, 8 and 20 volts full scale of either polarity.

The sensitive DC VTVM can be used for measuring transistor and electro-chemical potentials, voltages of charged capacitors, DC amplifiers and computers, and as a null indicator in high resistance circuits. Measurement of low current in photocells, semiconductors and ion chambers; volume resistivity measurements, and matching high-megohm resistors will also be possible.

Pre-Cut Shapes for Master Layouts

New self-sticking narrow width tape and pre-cut terminal shapes made by W. H. Brady, 727 West Glendale Avenue, Milwaukee, Wisconsin, make faster layouts for photo reproduction of printed circuits.

Brady No. B-150 tape can be used to make printed circuit master layouts on glass cloth or acetate or to make "splash etch" prototypes.

The draftsman positions the self-sticking shapes and strips of tape on the board, or he can use the pre-cut strips and shapes laying out the circuit pattern directly on a copper clad. After an etching bath, the shapes provide sufficient resistance and a rough "bread-board" prototype results.

Once the final circuit layout is decided, a master print is "drawn"—

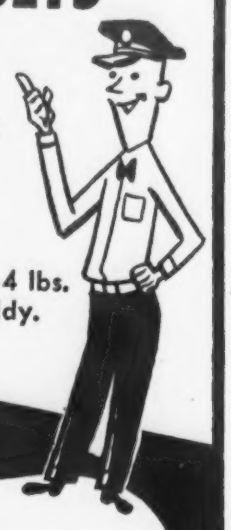
(*Continued on page* 124)

Costs only $29.95 Slightly higher in West

QUICKLY PAYS FOR ITSELF MANY TIMES OVER!

"Hard to Find" TUBE FAULTS LOCATED FAST!

Truly Portable!
6½" x 6½" x 2½"—4 lbs.
Carry in Tube Caddy.



NOW WITH EXPANDED TUBE LIST FOR UP-TO-DATE TV & INDUSTRIAL TUBE TESTING

MODEL GCT-5
SECO
GRID CIRCUIT
TUBE TESTER

The SECO GCT-5 is specifically designed for detecting "Control Grid" failures in high-transconductance tubes where the cathode and grid spacing is at a minimum.

Only SECO has the suitable circuit capable of tracking down these critical tube faults — helps you to obtain "top-notch" performance from electronic equipment!

Tubes in this category are found in all types of electronic equipment. The grid condition must be "clean", if one expects peak performance.

The following are examples of circuit applications where the SECO GCT-5 TESTER can do an excellent culling job.

A. RF, IF, AGC, APC and SYNC circuits in all types of communication equipment, instrument landing and radar equipment.

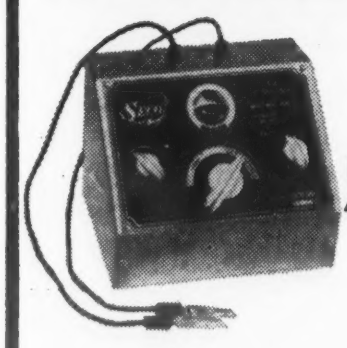
B. Computers and counter applications.

In addition to the SECO exclusive grid check feature, other inter-element leakages are simultaneously detected.

TAKE THE GUESS WORK OUT OF TUBE TESTING!

Obtain a SECO GCT-5 on approval. See your distributor or contact us for the names of distributors in your area. We can also equip you with a tester for specialized applications to exactly fit your needs.

SECO serves the serviceman RIGHT with tested, indispensable instruments



SECO
Model FB-4
FLYBACK CIRCUIT AND INDUCTANCE ANALYZER
$38.95
Slightly higher West

Requires no disconnecting, no charting; gives a fast, simple 'yes' or 'no' answer *at a glance.*

SECO
Model SL-10
MONITRON SIGNAL TRACER AND INTERMITTENT LOCALIZER
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The solution to your troublesome INTERMITTENT problems . . . monitors circuits without attention!

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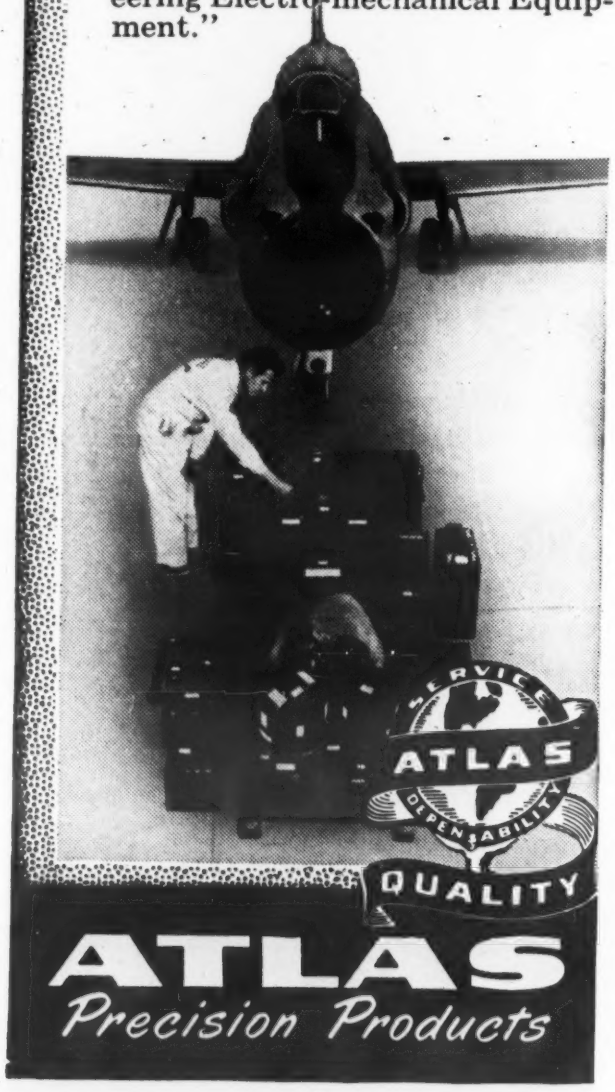
ATLAS Precisioneers "HUSH-HUSH" Assemblies for THE FALCON

● NO HIDING place "upstairs" for enemy bombers with *The Falcon* on the hunt. This newest guided missile is being produced for the U. S. Air Force by Hughes Aircraft Company.

Some of the "innards" of this bird of prey are ATLAS-Precisioneered and classified "confidential." But there's no secret as to how ATLAS can help you develop parts and assemblies from pilot stage to production efficiency for radar . . . sonar systems . . . computers . . . correctors . . . all types of electro-mechanical devices. Just bring your designs to ATLAS. At your disposal *on a job* basis are our men, equipment, techniques; a prototype is turned over to you for volume production.

When war or peace demands a product, call on ATLAS Precision Products Co. (div. of Prudential Industries), Philadelphia 24, Pa.

Send for booklet, "Precisioneering Electro-mechanical Equipment."



NEW PRODUCTS

again using Brady narrow width connector strips, terminal circles and special "lands." The master layout is then photographed, and duplicates are produced using familiar processing techniques.

Eighteen yard long rolls of narrow width tape are available from stock in 6 widths ranging from $\frac{1}{32}$" to $\frac{1}{4}$". Special widths in any dimension from 1/64" wide to $\frac{1}{2}$" wide can be ordered. Width tolerances of plus or minus .005" assure sharp, accurate reproduction of printed circuit patterns.

Index to Electronics Patents

A comprehensive index to United States electronics patents has just been issued by Information for Industry, Inc., 1108 16th St., N. W., Washington 6, D. C.

Available on a subscription basis, the patent information is listed concisely and clearly by a unique indexing system. Under the system, complex electronics subjects are reduced to "uniterms" or basic words, marking the initial step toward much-needed standardization of electronics vocabulary. As a supplement to the index, a cross-reference list of the actual patents and drawings is issued.

The index that is presently available is for electronics patents issued during 1955. The company will issue another index by the end of August that will include patents from January through July 1956, and a full index for 1956 at the end of the year.

Information for Industry, Inc., has issued a uniterm index of chemical patents for the past two years which has received wide acceptance from the chemical industry.

Anticipated applications for the electronics industry include such fields as: research, sales and marketing, product development, design, and libraries.

Very Thin Teflon Tape

Teflon tape .0005" thick is now available from the Enflo Corp., Route 38, Airport Circle, Pennsauken, New Jersey. Other Enflo tapes of .001" and .0015", as well as conventional thicknesses from .002" to .060" and in widths from $\frac{1}{2}$" to 12", have also been announced.

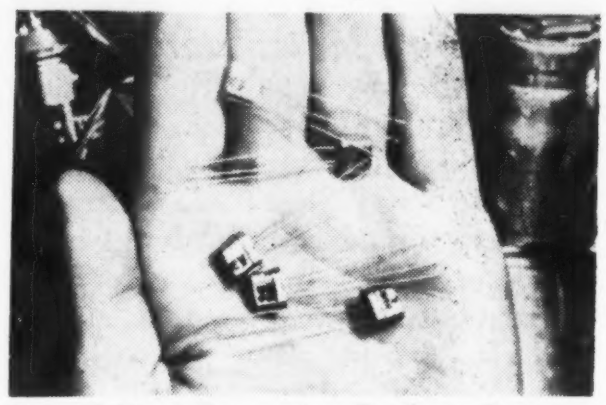
The Enflo .0005" tape provides greater Teflon coverage at lower cost and finds wide use in capacitors, transformers, and for both wrapped and sintered wires and cables. The thinner tape gives adequate dielectric strength with less Teflon area.

Silicon Transistors

A revolutionary transistor made of silicon has been developed by Germanium Products Corporation, a subsidiary of Bogue Electric Manufacturing Co., 52 Iowa Avenue, Paterson, New Jersey.

Silicon insures the elimination or reduction of bulky cooling equipment from aircraft and missile apparatus because the abundant material does not break down under very high temperatures. Savings of space and weight will lessen the need of aircraft fuel and power needs and will increase performance.

Potential uses will range from tiny wrist radios to color television, hearing aids and hi-fi sets to inter-continental rockets and guided missiles.



Five of these Germanium Products Corporation's tiny silicon transistors, plus some simple miniature batteries, equal the combined output of several electronic components.

Moisture-Proof Microphone

Designed primarily for motorcycle two-way equipment, a new carbon microphone has been developed by the electronics division of Elgin National Watch Company of Elgin, Illinois.

Built for ruggedness in mobile communications, the mike can be shielded with a special rubber boot making it completely moisture proof.

Known as the C504C, the microphone has a Bakelite case, is $2\frac{1}{8}$" by $1\frac{5}{16}$" in size and weighs 9 ounces. With a 40 ohms impedance and a frequency response in the 200 to 5,000 cps range, the microphone is used as a close talking unit.

Two-Post Wire Terminal

For making single pair junctions between rural and urban distribution wire and drop or bridle wire, a new two-post wire terminal has been designed by Reliable Electric Company, 3145 Carroll Avenue, Chicago 12, Illinois.

This terminal is comprised of a molded plastic body with molded-in binding and mounting posts and a flexible neoprene cover. The slots in the sides of the body provide guides for the conductors of the distribution wire, while the slot in the bot-

(*Continued on page* 126)

THE Y-4 PERISCOPE BOMBSIGHT *used in B-47 Stratojets has 3,433 parts, nearly 2,000 of them in this head-end assembly alone. General Mills manufactures this precision instrument in quantity under a USAF prime contract.*

No need to swamp your staff with piece part and assembly problems...

Let General Mills supply the whole package

Eliminate the thousands of detail problems involved in turning out complete electro-mechanical assemblies—and save money, too!

The Mechanical Division of General Mills is ready to manufacture or purchase component parts, assemble to your requirements, and deliver assemblies performance-tested to rigid Government standards—on time. We have the experience and equipment required to take over the complete job. The highest precision standards are maintained in engineering, manufacture, quality control, packaging and accounting.

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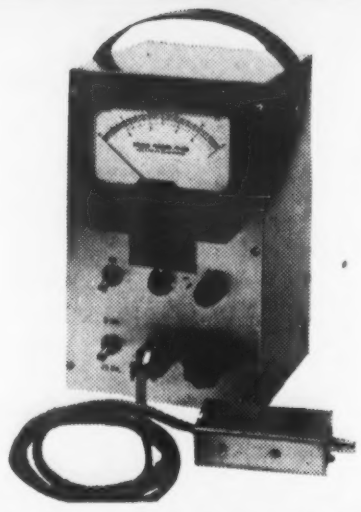
Job opportunities available for creative engineers. Work closely with outstanding men on interesting projects.

MECHANICAL DIVISION OF General Mills

RIXON NS - 198
DIODE NOISE SOURCE



A device for the determination of equivalent noise in HF-VHF receiving systems.
The NS-198 Diode Noise Source employs the anode current of a temperature limited diode to generate a noise voltage.
Noise figure is read directly from a linear meter which is accurately calibrated in db.

RIXON ELECTRONICS, INC.
2414 Reedie Drive
Silver Spring, Maryland

NEW PRODUCTS

tom of the body is for the drop wire or wires to enter.

It is complete with stainless steel channel washer to clamp over the support wire and grooves on each side to guide the support wire. The neoprene cap provides a weather-tight covering with a 20 to 30 year life expectancy.

Low Torque Potentiometers

Circuit Instruments, Inc., 1927 First Avenue South, St. Petersburg, Florida, has introduced their Model "B" High Precision Potentiometers.

These units have been developed to meet the requirement for maximum accuracy, reliability, and quality in a single-turn, wire wound potentiometer. As far as practicable, characteristics have been established in accordance with the standards of the Radio-Electronics-Television Manufacturers Association and the Aircraft Industries Association.

Model "B" potentiometers are available in standard case sizes from 7/8" to 3" in diameter with a wide range of standard resistance values between 100 ohms and 600,000 ohms. Standard units feature ultra-low torque through miniature precision ball bearings. The more economical low-torque journal type bearing is also available. Either bearing may be incorporated in the tapped hole or optical servo mounting provided.

Any model may be provided with several sections ganged on a single shaft, band coupled for "in-the-field" phasing. Most models in this line are available with both linear and nonlinear windings. Units can be provided with materials permitting operation at ambient temperatures up to 150°C.

New Multi-Trace Oscilloscope

A multi-trace oscilloscope, production Model 2400, has been announced by Railway Communications Inc., Raytown, Missouri.

The instrument is used in waveform study of telemetering, servo response, vibration and stress analysis.

Using a 17 inch picture tube for simultaneous multiple channel reproductions, the oscilloscope utilizes separate input circuits which control position and intensity of the individual trace lines. Also incorporated in this unit is a dotting circuit, a vectoring circuit and sweep circuits with ranges varying from 0.5 cps to over 500 cps.

The front panel includes all adjusting controls, and the rear panel accommodates all input circuits. This multi-trace oscilloscope can be furnished in a number of variations depending upon the requested requirements.

Duodecal Electron Tube Socket

Designed specifically for use with 2BP1 and 2BP11 cathode ray tubes, a duodecal electron tube socket has been announced by the Electronic Sales Division of DeJur-Amsco Corporation.

An easily removable socket cap provides complete protection for each individual connection. Wires can be brought out radially from the housing for grouping in a neat, compact cable assembly. Extra barriers provide long creepage paths for high breakdown voltages — 6500 volts RMS at sea level and 1500 volts RMS at 60,000 ft.

Molding compound is mineral filled melamine (MIL-P-14D, Type MME). The contacts are made of beryllium copper and silver plated.

Additional information and outline drawings can be obtained by writing for Bulletin 50A from the Electronic Sales Division, DeJur-Amsco Corporation, 45-01 Northern Boulevard, Long Island City 1, N. Y.

TO THE
MEN WITH
WAVEGUIDE
PROBLEMS

VISIT BOOTH 44 A.F.C.E.A. SHOW

- **Get Technical Data On New Ridged Waveguides**
- **Learn About Our Special Facilities For Assemblies**
- **Discuss Projects With Our Waveguide Specialists**

TECHNICRAFT LABORATORIES • THOMASTON, CONNECTICUT

NEW PRODUCTS

Airtron Microwave Rotary Joint

A microwave rotary joint with a peak power rating exceeding 600 kw at atmospheric pressure has been developed by Airtron, Inc., 1103 West Elizabeth Ave., Linden, New Jersey.

Available in both unsealed or pressurized versions, this new rotary joint is used with 1.250×.625 wave-guide. Other characteristics include a maximum VSWR of less than 1.10 over the frequency range of 8500-9600 mc. Variation of VSWR with rotation is negligible throughout the total angular travel.

Accuracy of rotation is maintained by large diameter pre-loaded bearings. An "0" ring gasket furnishes pressurization to protect the weather side of the bearings from corrosion and dirt contamination.

Sub-Miniature Selenium Rectifiers

Bradley Laboratories of 169 Columbus Ave., New Haven, Connecticut, have introduced a new line of subminiature selenium rectifiers. The rectifiers can be used in portable and airborne communications and other electronic equipment where space and weight limitations are major factors.

Important features are: low forward drop combined with low reverse leakage, uniformity of electrical characteristics from stack to stack, reliability and the ability to perform at high ambient temperatures.

Rectifiers have 3/16 inch, 5/16 inch and ½ inch diameter plates. Half wave types are supplied from 0 to 148 volts peak inverse, full wave types from 0 to 74 volts peak inverse with ratings to 25 ma DC. A variety of electrical circuits involving from 1 to 4 plates are available.

Anesthograph

Anesthograph, produced by the Edin Co., Inc., 207 Main St., Worcester, Mass., now provides a means of measuring the depth of anesthesia during surgery. The compact unit is for clinical use in the operating room to monitor the amount of anesthesia absorbed by the patient and to record his heart condition.

The Anesthograph simultaneously records brain-wave patterns from an electroencephalograph and the heart-action tracings from an electrocardiograph, all of which is incorporated in the one instrument. A positive indication of brain activity is pro-

(*Continued on page* 128)

TACTICAL TELEPHONY for a MODERN ARMY

These units are typical of ground communication equipment built for the Armed Forces by North Electric Company.

ON THE LINE

This SB-22 basic 12-line unit was designed at Fort Monmouth to meet tactical requirements in combat areas. Weighs less than 22 pounds. Built into case for easy handling.

Operated here as a field switchboard, it is also used in combinations as shown below.

AT BATTALION LEVEL . . .

Magneto telephone switchboard for field use. Combines two or more of the SB-22 units shown above.

AT REGIMENTAL HEADQUARTERS or equivalent level

Thirty-line SB-86 switchboard for magneto or common battery operation. Expands to 60 lines with addition of another jack field like upper portion at right or may be used in conjunction with several SB-22 units as shown here.

U.S. Army Photographs

North also makes BD-100 teletypewriter switchboards, voice or signaling carrier, repeaters for field lines, and telephones. We are proud of a long record of performance in providing Armed Forces communications

with **NORTH** Telephone Systems

NORTH ELECTRIC COMPANY

457 S. Market Street Galion, Ohio

vided which is translated onto anesthesia level.

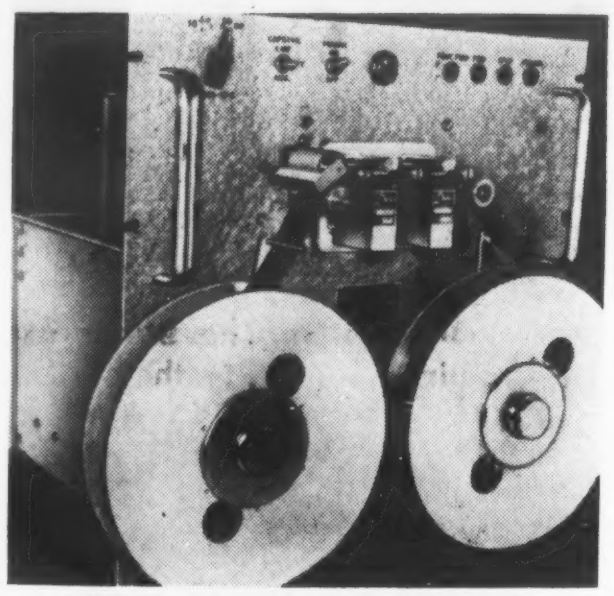
Close control of anesthesia made possible by the Anesthograph will increase the practicability of surgery on many patients. The instrument can quickly determine danger signals not apparent to the anesthetist who relies on visual observation.

Clevite Power Transistors

Six new germanium power transistors produced by Clevite Transistor Products, 241 Crescent St., Waltham, Mass., can handle up to 20 watts input. The new transistors are PNP power junction type and were originally developed to meet U. S. Signal Corps specifications.

Types are available for nominal 12 and 28 volt operation, making them suitable for direct use in battery powered equipment. They are particularly suitable for class A operation in the audio output stage of automobile radios.

The collector is electrically connected to the metal housing, but where it must be insulated from the chassis, a large mounting flange permits rapid heat flow through the insulating material.



Davies magnetic tape transport.

Magnetic Tape Transports

Great flexibility characterizes the two new tape transports produced by Davies Laboratories, Inc., 4705 Queensbury Road, Riverdale, Maryland.

The Type 102 transport utilizes one single or multiple speed hysteresis synchronous motor to belt drive the capstan.

The Type 103 operates with one or two single, dual, or triple speed hysteresis synchronous motors to drive the capstan at any one of six speeds. Since the capstan is driven through a magnetic clutch-controlled belt-driven speed reducer, speeds may be directly selected from a panel switch, without changing belts or capstans.

Available for reel sizes to 10½", tape widths from ¼" to 2" in ¼" increments, the units will each take one or two Davies multi-channel recording heads. Idlers and a tape loop roller panel are also available.

Waveguide Switch

A compact, airborne waveguide switch has been made available by the Electronics Division of Thompson Products, Inc., 2196 Clarkwood Road, Cleveland 3, Ohio.

Of interest to the microwave field is the ¾" by 1½" guide size switch with the following features: VSWR-1.05 maximum in position, 1.15 maximum during switching; cross-talk-45 db minimum; actuator-28 V DC actuation time—0.5 sec. maximum; power handling ability—approximately 0.35 megawatts cw.

Mounted High-Precision Crystals

In a newly-designed Kel-F mounting, high-precision crystals for commercial and amateur use in frequency ranges from 800 to 2000KC are being produced by Standard Crystal Company of 1714 Locust St., Kansas City, Missouri.

Designed for close-tolerance applications, these Standard SC-6A crystals have four post mounting providing protection against vibration up to 250 cps and shock exceeding 100 Gs.

The Kel-F mounting affords mechanical support and shock-absorption without interfering with the electrical characteristics of the precision-finished quartz plate. The hermetically-sealed units will operate under both controlled and non-controlled temperatures up to 120°C.

High Voltage DC Power Supplies

Beta Electric Corporation, 333 East 103rd Street, New York 29, N. Y., has introduced a new line of high voltage DC power supplies. The rack-mounted power supplies can be used for vacuum and cathode ray tube testing, insulation testing, nucleonics research and electrostatic processing.

These variable units are available in outputs of from 0-1000 volts to 0-60,000 volts in eleven ranges from 600 milliamperes at 1 kilovolt to 1 milliampere at 60 kilovolts. Each unit contains output voltage meter, overload relay, over-voltage protection, malfunction indicators for con-

(Continued on page 130)

VECTRON

Of Waltham, Massachusetts

Invites you to consider its facilities for the contract or subcontract **manufacture** of mechanical and Vectron mechanical assembly.

If you cannot visit our display at **AFCEA Exhibit Booth 62** let us send you our illustrated facilities brochure and our latest plant equipment listings.

Write to B. J. Warren

Vectron, Inc.
1603 Trapello Road
Waltham 54, Mass.

or phone Twinbrook 3-8700 today!

ONLY *THIS* PROFESSIONAL VHF COMMUNICATIONS RECEIVER GIVES YOU

- **Exclusive Automatic Noise Limiter**
- **Exclusive Squelch Control**
- **Continuously tunable over entire frequency range of 50-200 mc without switching**
- **Less than 50 micro-micro watts radiated power as measured across the 50-ohm antenna input terminals**

plus ***these quality features***

- AM-FM-c.w. selection
- Patented 72" bandspread dial with accuracy of 0.25%
- Beat-frequency oscillator
- Variable selectivity across entire bandwidth
- Antenna trimmer
- Continuously operable — no shut-down time required
- Sensitivity: 1 micro-volt input or less will produce a 10-db signal plus noise-to-noise ratio over entire frequency range
- Stability: effective over line voltage of 105-125 volts . . . better than 0.08% over a —10°C to + 60°C temperature and ambient humidity of 0 to 95%

MODEL R5200

19" wide, 8¾" high,
14" deep, excluding cabinet

You'll find this VHF Communications Receiver used in the laboratory to calibrate other receivers; in flight-testing; control tower; propagation studies; evaluating transmitters; meteor research; and of course, as a general, all-around communications receiver. Built to the most exacting standards.

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NEW HYDE PARK, L. I., N. Y.

trol circuits, fuses and switches, and holding relay for locking-in voltage

Negative, positive, reversible, center-tapped or reversible center-tapped polarity designs are available. With voltage ratings of 30 kv or less, the H.V. section is air-insulated, while in higher ratings it is oil-insulated. Most designs use selenium rectifiers with current ratings of 20 milliamperes or below.

New Literature

Bomac Microwave Tubes And Components

A new 6-page folder released by Bomac Laboratories, Inc. of Beverly, Mass., gives a partial listing of microwave tubes and components and their specifications.

TR, ATR, Pre-TR and attenuator tubes, special shorted TR and ATR tubes, dual and triple TR and ATR tubes, pressurizing windows, spark gap tubes, silicon diodes, magnetrons, shutter tubes, klystrons, hydrogen thyratrons, and travelling wave amplifier tubes are included in representative pictures and descriptions.

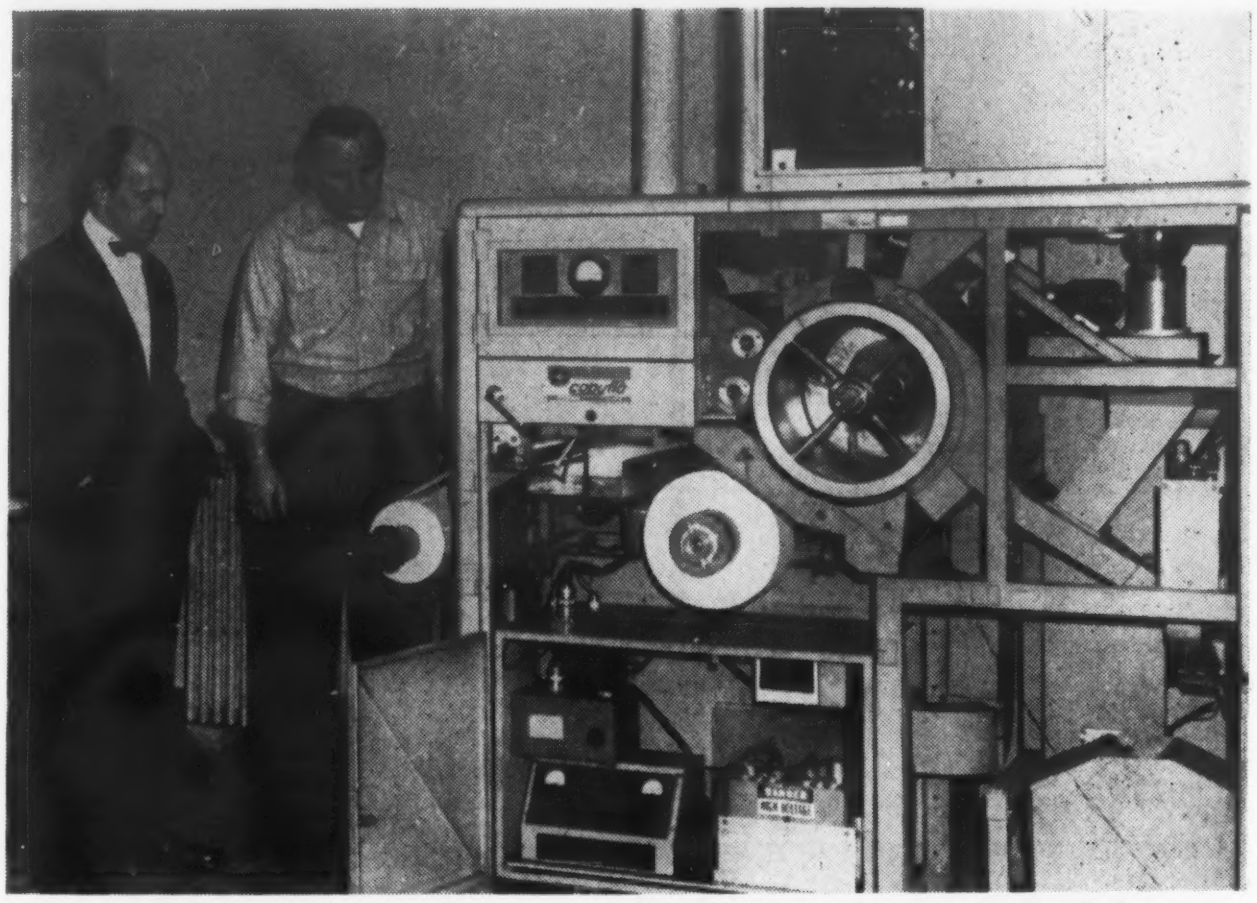
Filtron Capacitor Catalog

A new line of low-pass feed-thru suppression capacitors available from Filtron, is described in a 5-page, two color catalog. Trade-named Fil-Caps, the feed-thru units have an internal circuit arrangement which makes ground-to-line inductance negligible over a very wide frequency range (100 kc to 1000 mc).

The text provides complete information on construction features and operating characteristics such as: specially processed silicone impregnant to improve electrical characteristics; positive contact to ground; milled flats to prevent rotation under vibration; glass-to-metal compression hermetic sealing, and continuous operation under temperature variation.

Complete engineering data on rated current and voltage, insulation resistance, capacitance and dissipation factor are specified. A list of Filtron part numbers and their military equivalents is also provided.

Catalog FV may be obtained from Filtron Co., Inc., Flushing, Long Island, New York.



C. P. McColough, left, general manager of the Haloid Company's new XeroX Processing Laboratories in Chicago, and George Michalik, operator, examine prints coming from the newly developed XeroX Copyflo continuous enlarger. Using the dry, electrostatic principle of Xerography, this device is capable of printing from either 16 or 35mm film at a speed of 20 feet per minute. Copyflo takes either perforated or unperforated film, and reproductions may be made from either positive or negative film, but not when intermixed.

Reference Guide for Electron Tubes

CBS-Hytron, a Division of Columbia Broadcasting System, Inc., has revised and brought up-to-date a new edition of its listing of all miniature tubes, regardless of make. The eighth edition of CBS *Reference Guide For Miniature Electron Tubes* supplies pertinent data for 416 miniature types of which 88 are new, and 168 basing diagrams of which 33 are new. This 16-page brochure also lists prototypes in larger bulbs.

This reference guide, Bulletin No. PA-1, can be obtained free of charge from distributors of CBS tubes and semiconductors, or by writing to CBS-Hytron, Danvers, Mass.

For the Photographer

SX Pan, DuPont's New Fast Film

DuPont Photo Products Department in Wilmington, Delaware has introduced to the photographer a new fast, wide latitude photographic film, SX Pan.

Particularly suited for good results in a variety of conditions, SX Pan has an exposure index set conservatively at 300 daylight and 260 tungsten. Much higher speeds can be used effectively with the wide-exposure-development latitude of SX Pan.

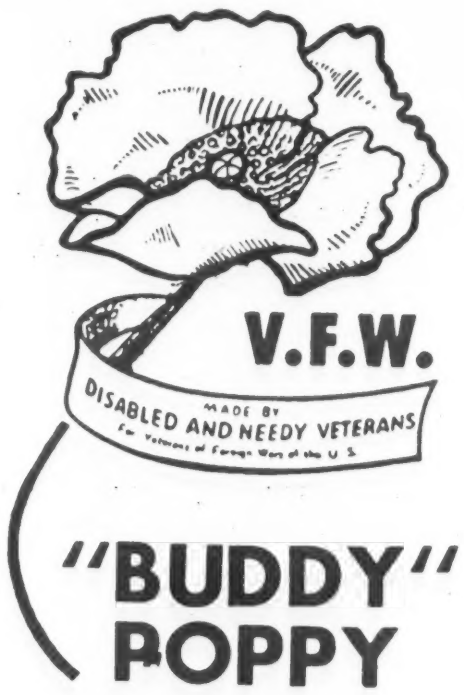
Good results can be obtained on SX Pan exposed at speeds of 1,000 or over by processing the film in DuPont 6D developer for approximately 12 minutes at 75°F. Normal development time for SX Pan is eight minutes in 6-D at 68°F., for a gamma of 0.78.

The new film is available in 35 mm, 70mm, 1 13/16-inch and 2 1/16-inch widths with 100 to 1,000-foot lengths and other professional roll film sizes.

New Kodak Films

Eastman Kodak has introduced two new types of film. A new Kodak Verichrome Pan has replaced the former Kodak Plus X and Super XX paper-backed roll films. ASA exposure index of the Verichrome Pan is 80 for daylight and 64 for tungsten.

Kodak has also developed a new orthochromatic film to be known as Kodak Royal Ortho film. Increased speed of the Royal Ortho is comparable to the fastest of panchromatic films, and there is no increase in grain. Available in all standard sheet film sizes, Royal Ortho's daylight exposure index is 200; tungsten is 125.

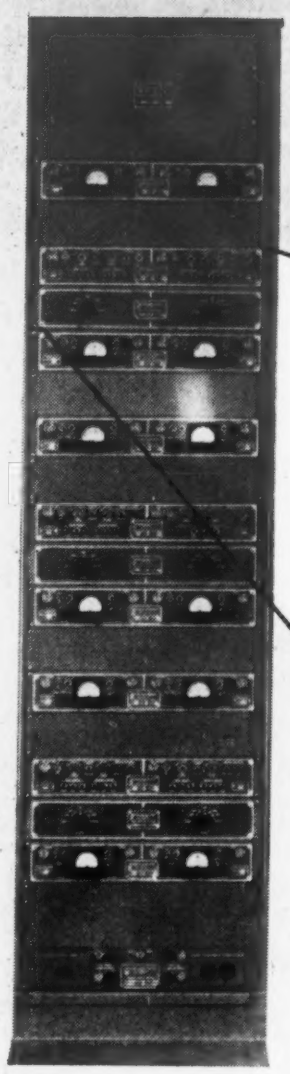


Never before... Duplexing and Break-In *Without* Relays

NEW! **Northern Radio**

DUPLEX TELEGRAPH SYSTEM

For Multi-Channel Tone Equipment



Dual Duplex Selector Panel Type 200 Model 1

Dual Loop Switch Panel Type 200A Model 1

NEW!
Simple 4 position switch selects from 12 possible duplex combinations.

NEW!
Duplex operation between stations connected via carrier telegraph channels.

NEW!
***All-electronic,* without relays or moving parts to wear.**

NEW!
Polar or neutral for either half duplex or full duplex.

NEW!
Break-in now also possible for all *half*-duplex circuits.

NEW!
Provided with positive feature to prevent space signal lock-out.

NEW!
Includes individual line battery for each channel.

The Northern Radio Duplex Telegraph System consists of one each Dual Frequency Shift Tone Keyer, Type 153 Model 3; Dual Duplex Selector Panel, Type 200 Model 1; Dual Loop Switch Panel, Type 200A Model 1; and Dual Frequency Shift Tone Converter, Type 152 Model 3. The Frequency Shift Tone Keyer and Converter are our latest improved Model 3's, specifically designed for use with this system.

The Dual Duplex Selector Panel and Dual Loop Switch Panel make possible complete duplexing and break-in operation of a Northern Radio or similar multi-channel Frequency Shift tone telegraph system. Such a system meets the requirements of any standard telegraph line or terminal apparatus for either full duplex or half-duplex operation. Because this system is all-electronic, it meets all speed requirements and yet has the flexibility and isolation heretofore possible only with relays.

The Dual Loop Switch Panel rapidly selects half-duplex and/or full duplex mode of operation for any of the 4 standard loop options by front panel switching available from the 12 loop options in the Dual Duplex Selector Panel.

The Dual Duplex Selector Panel provides 12 loop options, patching facilities for monitoring purposes and channel routing, including the possibility of patching-in another teleprinter loop circuit (T-junction). Any of the 12 loop options are available and may be selected for the Dual Loop Switch Panel by simple strapping arrangement. It has an individual line battery for each channel for greatest circuit flexibility. Battery and line fuses are also provided for maximum protection.

The Dual Duplex Selector Panel is provided with positive non-lockout features. An accidental "spacing" of the line, even over prolonged periods of time, such as caused by patching errors, will not lock the system into a permanent space (no loop current) condition. The system will instantly be ready to operate as soon as the fault is removed. This is due to a novel arrangement of the internal batteries which at all times can provide power to the telegraph loops.

Pace-Setters in Quality Communication Equipment

NORTHERN RADIO COMPANY, inc.

147 WEST 22nd ST., NEW YORK 11, NEW YORK

In Canada: Northern Radio Mfg. Co., Ltd., 1950 Bank St., Billings Bridge, Ottawa, Ontario.

ELECTRONICS, by A. W. Keen, Philosophical Library, New York, N. Y., 256 pages, $7.50.

For the non-technical reader and student, this book is written as an introduction to all aspects of electronics.

The author has attempted to present in elementary but accurate terms a comprehensive account of electronic devices and their applications.

Although the treatment is necessarily superficial because its subject is broad and complex, this book should give anyone with a sound knowledge of elementary electricity and magnetism a clear idea of the nature and scope of electronics.

HI-FI LOUDSPEAKERS AND ENCLOSURES, by Abraham B. Cohen, John F. Rider, Inc., New York, N. Y., 360 pages, $4.60.

This book is designed to answer all questions of the hi-fi enthusiast and audio technician that pertain to high-fidelity loudspeakers and enclosures.

The book is divided into three sections: "The Loudspeaker," "The Enclosure," and "The Room." In the first section the reader is taken from the basic loudspeaker principles toward an appreciation of variations which lead to the specialized high efficiency, high quality reproducers of today. Terms such as speaker resonance, impedance and damping are explained. Multi-speaker design information is included, along with an explanation of crossover networks for such speakers.

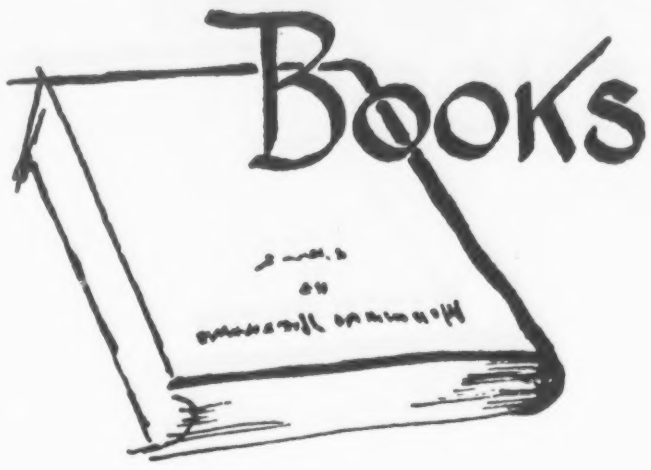
The second section analyzes types of loudspeaker baffles and enclosures. Charts and graphs are included to explain enclosure characteristics.

The third section deals with the listening room as part of the acoustic circuit and includes information on enclosure placement and room treatment and adjustment for best hi-fi reproduction.

An Appendix consists of 18 plans for the construction of loudspeaker enclosures of all types and for various speaker sizes.

ELECTRONIC MOTION PICTURES. by Albert Abramson. University of California Press, Berkeley and Los Angeles, California, 212 pages, $5.00.

Motion picture production is changing from a mechanical to an electrical process, as pointed out by this history of the television camera. The author brings the reader up to date with a brief but comprehensive survey of the history of the motion picture camera and sound recording.



The contributions of these two devices to early television are also discussed.

The future development of the camera is analyzed with a comparative study of the mechanical motion picture camera and the electronic television camera. The attempts to perfect the electronic camera and the recording process are revealed. The text notes England's activity in developing suitable closed-circuit cameras, not confined to broadcast standards, while in the United States, work is progressing on equipment for the magnetic recording and playback of the video signal.

The copiously illustrated text includes a thorough glossary of terms, and each chapter contains several pages of notes listing references for additional reading.

FRANK SMITH

AIR POWER, by Asher Lee. Frederick A. Praeger, New York, N. Y., 200 pages, $3.75.

This book is an attempt to rethink some of the aspects of past, present and future air power. The future of air power is both uncharted and unchartered. All one can say with certainty is that it will become even more important in the balance of military arms than in the past.

In separate chapters, each dealing with a single type of air operation—bombing, fighter defense, transport, anti-submarine, airborne troops, army co-operation, etc. — the author first points to the lessons which can be learned from World War II, then tries to assess the role which each type of operation might play in a future war. Subsequent chapters on air intelligence and the problems of combining the three services plead for more attention to be given to these vital matters.

In a final chapter Mr. Lee draws the threads together, surveys the revolutionary changes in air weapons of the last decade, and permits himself some well-informed guesswork about the future.

INTRODUCTION TO ELECTRICAL ENGINEERING, by Walter La Pierre. Harper & Brothers, New York, N. Y., 339 pages, $5.25.

To the student of engineering, this text gives a working knowledge of electric circuits and transducers highlighted against a background of general knowledge of this electrical age. Extensive and diverse, the material can help to develop an appreciation of the vast significance of electric energy in the United States.

The text covers elementary circuit theory, basic concepts, and some computational procedures. Then it moves into the discussion of generation, transmission, distribution, and utilization of electrical energy.

Economical, industrial, and social environments are brought into account for their necessary development of a fuller and more comprehensive understanding. Numerical examples, problems, and many complete diagrams offer a wide range of challenges to the student.

La Pierre has assembled this text to promote an educational aim involved in presenting a working knowledge of electric circuits and transducers set against a background of general knowledge in this electrical age.

Handbook: PREFERRED CIRCUITS, Navy Aeronautical Electrical Equipment, by J. H. Muncy, National Bureau of Standards. Government Printing Office, Washington 25, D. C., $1.75.

Published to promote savings for manufacturers and the military services through standardization of electronic circuits in military equipment, this looseleaf handbook presents 32 preferred circuits.

Included in the manual are voltage regulators, multivibrators, blocking oscillators, video detectors and amplifiers. Schematics and characteristics of each circuit are provided with other information to permit ready selection and construction. Successive pages explain use and design methods.

The preferred circuits presented were derived from experimental measurements made on a large number of examples of electronic equipment. A section of the handbook explains the steps which led to the selection and design of each circuit.

Our Book Department can furnish any book currently in print. We will also help to secure older copies that you may need to complete your library. A 10% discount allowed all Association members on orders of $10 or more. Please indicate author and publisher where known and allow three weeks delivery.

Now, *it's "earth satellites"*

The imagination of engineers, scientists, and laymen alike has been wetted by the exciting prospect of launching the first man-made earth satellites! Called project "VANGUARD," it is planned as the high-point of the world's longest "year"—the eighteen months between July 1, 1957 and December 31, 1958 of the *International Geophysical Year.*

First presented in a symposium, March 20th at the IRE Convention, this scientific, history-in-the-making event is detailed well in advance for you in the special June "earth satellite" issue of *Proceedings of the IRE.* Because it is written by men in charge of project development, this will be *the* basic textbook of applied electronic technology in the satellite field.

This definitive issue presents the working data of placing in orbit, construction of the satellite, telemetering and other pertinent information. Herein are stated the objectives and scientific gains to be achieved by the "earth satellite" program.

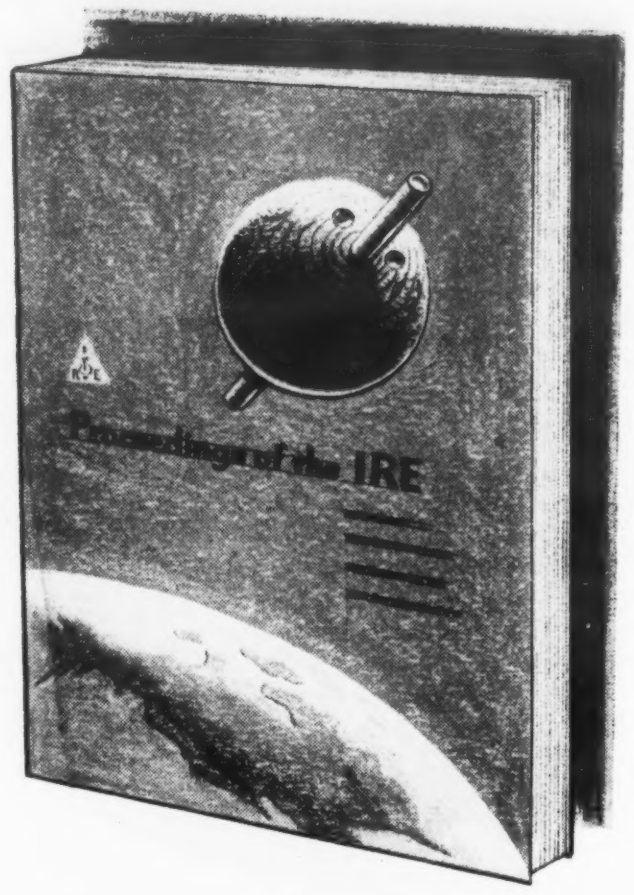
You will find in this special issue a complete explanation of:

1. tracking the missile—by radio and optics,
2. gathering data from the missile—by radio transmission, propagation, and intermittent reception from widely separate points on earth—and the rapid computations to be based on such data.

You will also find practical application of this development to other electronic fields in this up-to-the-minute symposium. You'll find the "satellite" issue of *Proceedings of the IRE* a publishing event of great value.

Price to non-members . . . $2.00

(All IRE members will receive this June issue as usual. Extra copies to members, $1.00 each.)



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"The Exploration of Outer Space with an Earth Satellite," by J. P. Hagen, Naval Research Laboratory, Washington, D. C.

"Placing the Earth Satellite in its Orbit," by M. W. Rosen, Naval Research Laboratory, Washington, D. C.

"Telemetering and Propagation Problems of Placing the Earth Satellite in its Orbit," by D. G. Mazur, Naval Research Laboratory, Washington, D. C.

"Tracking the Earth Satellite and Data Transmission by Radio," J. T. Mengel, Naval Research Laboratory, Washington, D. C.

"Optical Instrumentation of the Earth Satellite," by F. L. Whipple, Harvard University, Cambridge, Mass.

"The Scientific Value of the Earth Satellite Program," by J. A. Van Allen, State University of Iowa, Iowa City, Iowa.

The Institute of Radio Engineers

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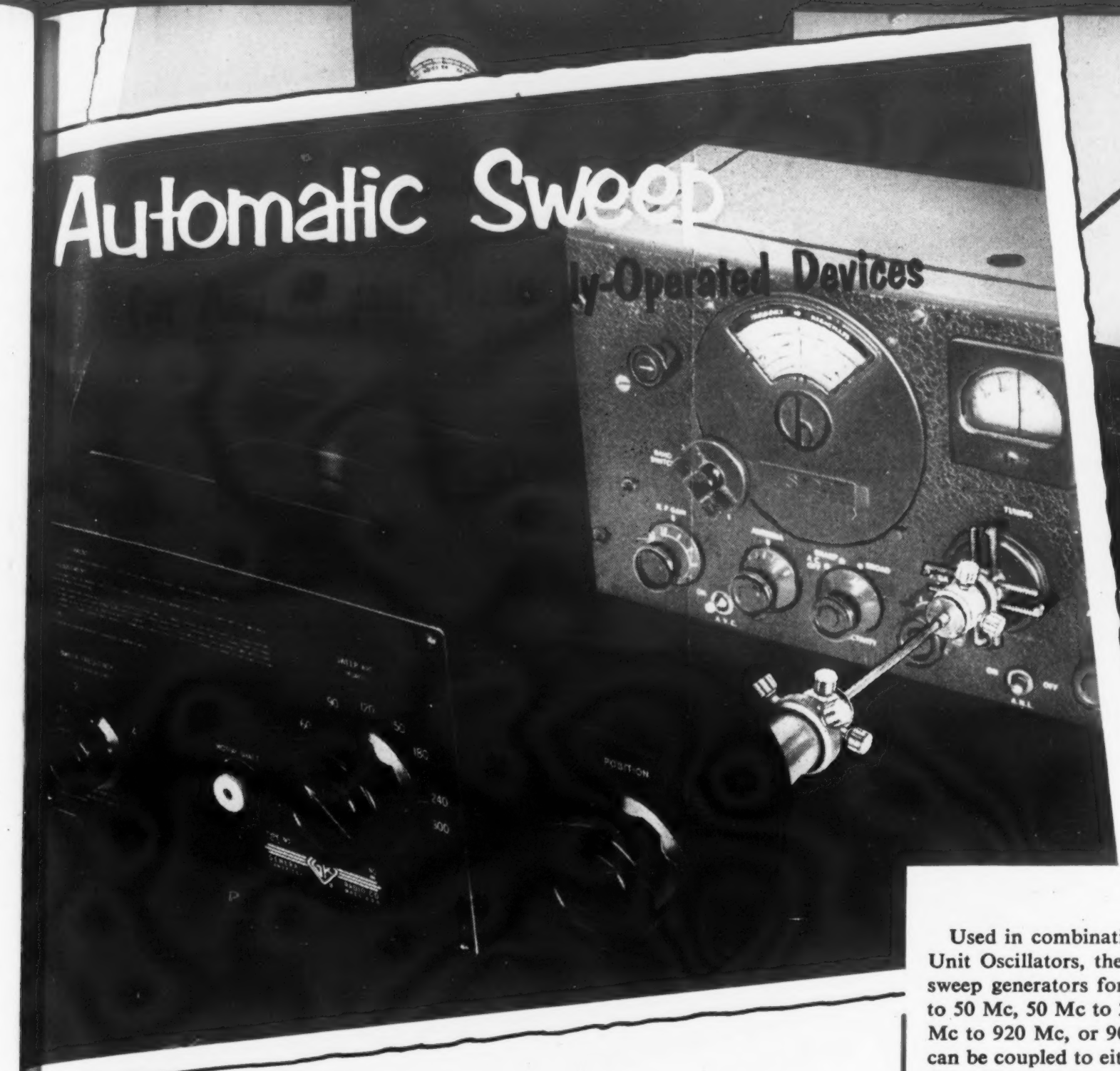

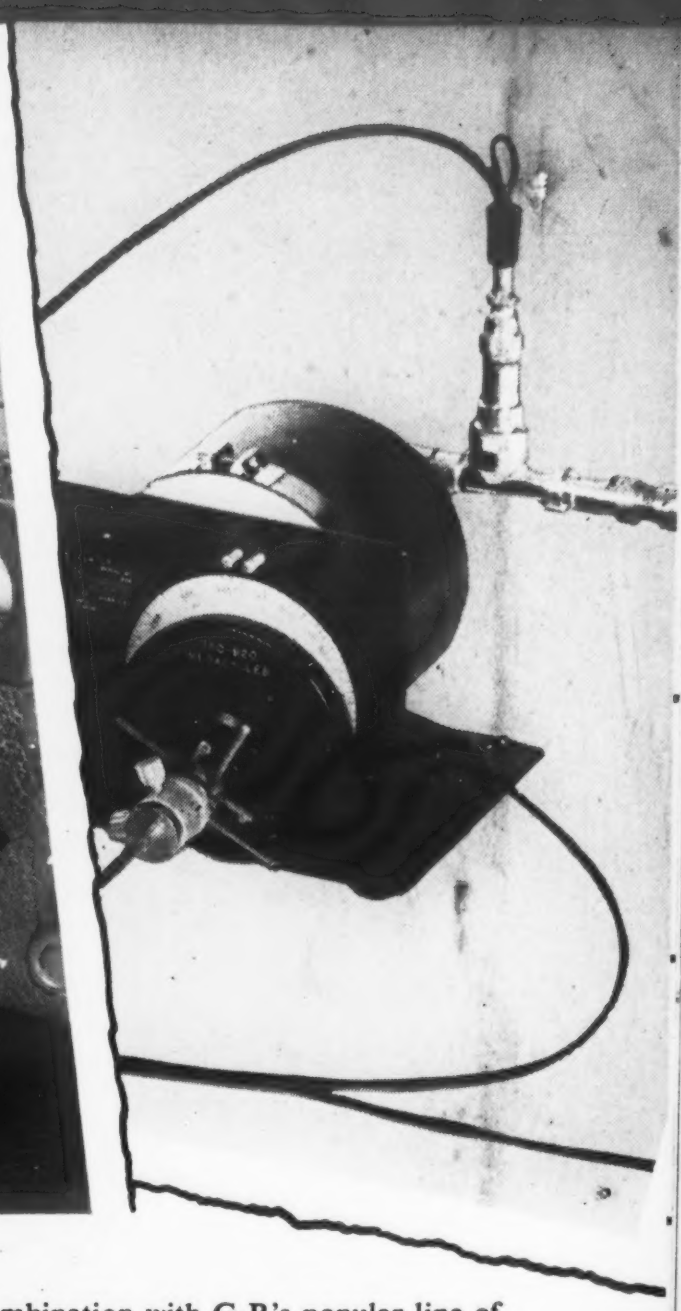

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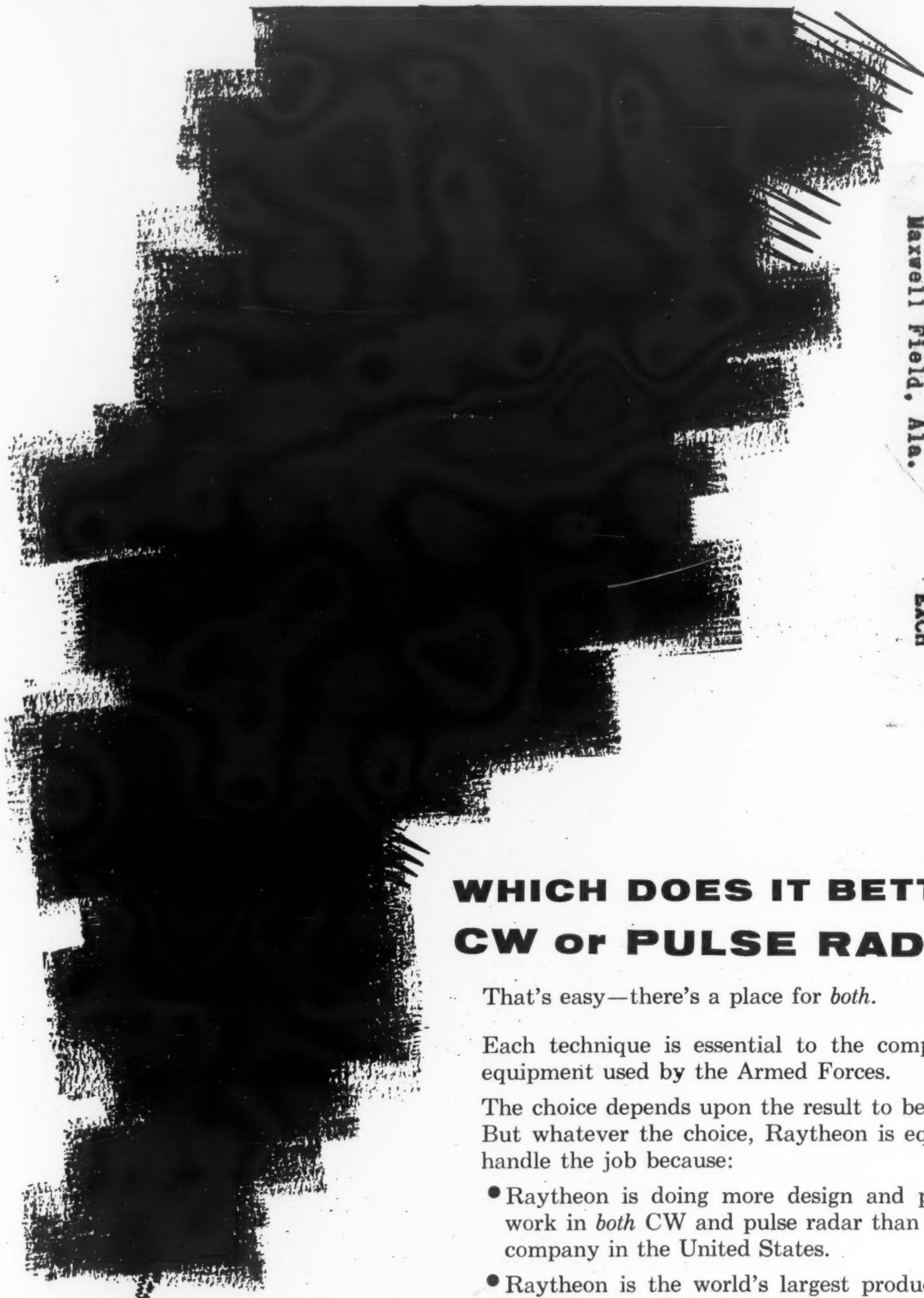

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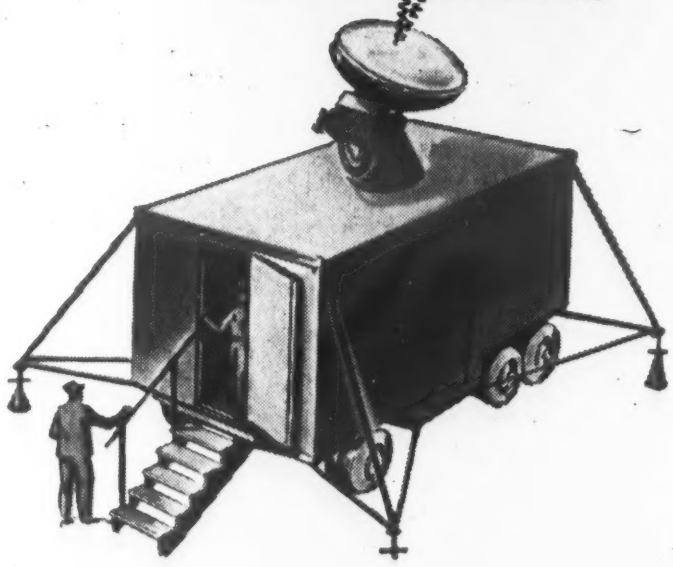

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